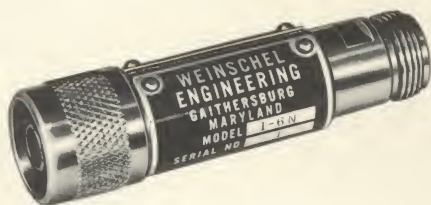
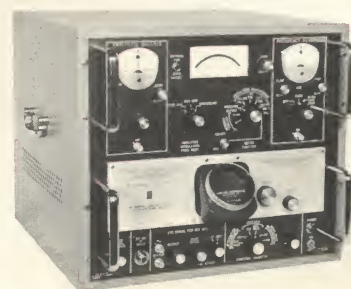


1966



MODEL 1

Condensed Catalog of Precision Coaxial Devices and Microwave Instruments



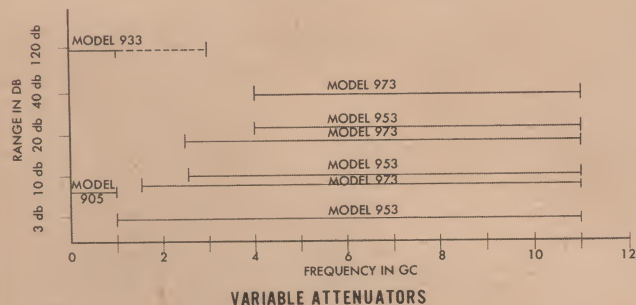
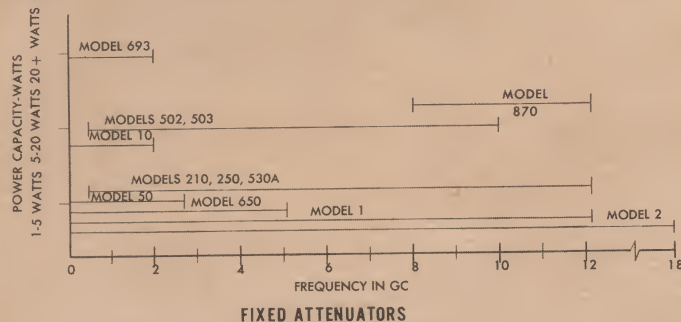
MODEL VM-3

**WEINSCHEL
ENGINEERING**

GAITHERSBURG, MARYLAND / SANTA MONICA, CALIFORNIA

THE PURSUIT OF PRECISION— We entered into the "Pursuit of Precision" with our first attenuator over 15 years ago. Our desire to build a more precise attenuator charted the course we have followed in the development of the products described in this catalog. Almost without exception, every item in the We product line is an outgrowth of the first attenuator. That first attenuator operated over a frequency range from DC to 1 Gc. Through our "Pursuit of Precision," this range was extended to 3 Gc—then 5 Gc—then 10 Gc—and is presently DC to 18 Gc. Are we satisfied now? . . . Behind each of these advancements is a host of new products which had to

ATTENUATOR SELECTION CHARTS: The charts below are provided to assist in determining which model attenuator to use for specific applications. If a model that meets your requirements is not shown, contact our Applications Engineering Department or your local We Sales Representative.



CLOSE TOLERANCE STAINLESS STEEL CONNECTORS: All We stainless steel type "N" connectors are assembled with extremely close tolerances. The critical mating dimensions are checked many times during assembly and test to assure proper mating with any other Type "N" Connector that conforms to the old MIL-C-71 specifications as well as the new closer tolerance MIL-C-39012 specifications.

CALIBRATION DATA: Complete calibration data is supplied with each We attenuator and termination. The Certificate of Calibration accompanies each attenuator. This data is obtained using the most refined insertion loss measuring techniques in combination with the most accurate instruments commercially available. The accuracy of the data is stated on the certificate and is fully guaranteed by Weinschel Engineering.

WEINSCHTEL ENGINEERING
P. O. BOX 577
GAITHERSBURG, MARYLAND

Certificate of Calibration
50-20 SERIAL NO. 59077

STANDARD TEST CONDITIONS FOR CLASS B CALIBRATION:
Ambient Temperature: 23°C ± 3°C
Relative Humidity: 50% ± 10%
Max. Power Input: 2 Milliwatts
VSWR Presented to Both Terminals: Less than 1.10:1 in a 50 ohm system.
Accuracy of Insertion Loss Calibration:

Attenuator	Frequency (KMc)	Attenuation (dB)	VSWR
At DC	± 0.1 dB	Up to 30 dB: ± 3 dB	MALE FEMALE
Up to 10 dB	± 1 dB	Up to 40 dB: ± 4 dB	
Up to 30 dB	± 2 dB	Up to 50 dB: ± 5 dB	

FREQ KMc	ATT DB	MALE	FEMALE
D.C.	19.95	1.03	1.04
1.0	20.0	1.03	1.04
2.0	20.0	1.06	1.06
3.0	20.0	1.10	1.07

Tester: *[Signature]*
Inspector: *[Signature]*
CALIBRATION STANDARDS AS APPLICABLE
ARE TRACEABLE TO THE NATIONAL BUREAU OF STANDARDS
13492 11/67

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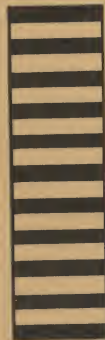
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GAITHERSBURG, MARYLAND 20760





WEINSCHTEL ENGINEERING

TECHNICAL ASSISTANCE REQUEST

- ☐ Please add my name to your mailing list.
- ☐ I am presently on your mailing list.
- ☐ Please remove my name from your mailing list.
- ☐ Please send me additional data on Model(s) _____

☐ Please send me a quotation on _____

☐ Please have an Applications Engineer contact me.

NAME _____

TITLE _____

COMPANY _____

ADDRESS _____

ZIP CODE _____

REASON FOR REQUEST

- ☐ Personal interest
- ☐ Literature for files
- ☐ Have future application
- ☐ Have immediate application

be developed before the attenuator could be improved. The precision of each of these new instruments and components is, in turn, constantly being pursued to increase their performance and reliability. These improvements have required research on and development of attenuator design principles, microwave resistive films, connector improvement, and instrumentation for the precise determination of power ratios, power, impedance and phase shift. Some of these items already appear in this catalog—Others will follow.

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INSERTION LOSS MEASUREMENTS: ♪ provides a selection of complete Insertion Loss Measuring Systems for Microwave Frequencies. Systems are available for measuring Insertion Loss in one step up to 35 db in the Single and Dual Channel Audio Systems or up to 100 db in the VM-1 or VM-3 I.F. Systems. Using a stable calibrated RF attenuator, these ranges are increased to 60 db and 140 db respectively. Accuracies range from 0.02 db per 10 db up to 0.1 db per 10 db. The systems and instruments, including ranges and accuracies, are described in detail in the Insertion Loss Measurements section (Page 16) of this catalog.

VSWR, IMPEDANCE AND PHASE SHIFT: The ♪ Stabilized SWR Indicator provides a 1.06 VSWR full scale expanded range. The high resolution and stability of this instrument when used in the ♪ Precision Tunable Impedance Measuring System allows the residual VSWR of the system to be tuned out to 1.002 using a ♪ sliding load as a coaxial impedance standard.

Microwave phase measuring instruments are available for a bridge set up capable of making phase shift measurements between 1 and 12 Gc with a resolution of 0.1° per Gc.

These systems and instruments are described in detail on Page 25 of this catalog.

MICROWAVE POWER MEASUREMENTS: ♪ Microwave Power Measuring instruments include a series of Thermistor Bridges for monitoring or establishing fixed power levels of 1 MW and 10 MW. Higher power levels can be monitored using a calibrated Thermistor Mount-Directional Coupler Combination. For the precise measurement of unknown power levels, the ♪ Model PB-1B will measure the substituted DC power in the thermistor mount to an accuracy of 0.1%.

♪ also makes available a complete line of **calibrated** thermally stable coaxial and waveguide thermistor mounts in the frequency range between 10 Mc and 18 Gc.

These instruments are described in detail on Pages 28-29 of this catalog.

MICROWAVE SOURCES AND POWER SUPPLIES: ♪ Microwave Sources and Power Supply-Modulators were specifically designed for use with the ♪ Insertion Loss Measuring Systems. They contain such features as output power with good amplitude stability which facilitates better isolation and provides for partial R.F. substitution to extend the measurement range. Also featured is 100% square wave modulation from an internal 1 Kc source or an external source with low incidental FM. In some units an internal 1 Kc tuning fork is used which has a 0.01% frequency stability. These instruments are described in detail on Page 30 of this catalog.



FIXED COAXIAL ATTENUATORS

MODEL 1 . . . DC-12.4Gc: The Ψ Model 1 Attenuator achieves its broad frequency range using a new patented* design principle. An attenuating card, used with a newly developed Ψ microwave resistive film, is the key to the design. These elements are extremely stable with time and are capable of withstanding overloads of either CW or pulse power without damage.

Each attenuator shows calibration data on the nameplate at DC and at intervals from 2 to 12 Gc. For maximum life and minimum wear, the Model 1 like all Ψ precision attenuators is fabricated of stainless steel, including the Type "N" connectors. The Model 1 also passes all environmental tests prescribed in MIL-A-3933A.

MODEL 2 . . . DC-18.0 Gc: The newest addition to the Ψ family of attenuators is the Model 2. This extremely broadband coaxial attenuator is the culmination of years of experience in the research and development of microwave components. The DC-18.0 Gc frequency range of the Model 2 is possible due to the new patented* design principle used in the Model 1, plus an entirely new Ψ semi-precision Type "N" connector that exhibits a low VSWR over the entire frequency range.

The Model 2, with its new connectors, extends the useful frequency range of coaxial systems over bands usually reserved for waveguide. The connectors, for use with rigid line or solid outer conductor cable, are presently available and described on page 15 of this catalog.

All Ψ Model 50 attenuators are calibrated to an accuracy which enables them to be used in extending the range of power meters or, for some applications, as standards in calibrating the insertion loss of other devices. Because of excellent match, they are also useful as buffer or isolation pads.

The attenuators are constructed using one or more T-pad sections carefully assembled from Ψ artificially aged and stabilized film resistors. The Model 50 pads have a very low temperature coefficient of attenuation because of the control of the temperature coefficient of the film resistors used and the inherent self compensation of the T-pad construction.

SPECIFICATIONS

IMPEDANCE: 50 Ω
FREQUENCY RANGE: DC to 3 Gc.
STANDARD NOMINAL VALUES:
 1 to 10 db in 1 db steps
 10 to 50 db in 10 db steps.
MAXIMUM DEVIATION FROM NOMINAL VALUE AT
DC: 1 to 10 db: ± 0.05 db. 20 and 30 db: ± 0.1 db. 40 and 50 db: ± 0.2 db.
FREQUENCY SENSITIVITY (Variation from DC Value at RF): ± 0.2 db max. for 1 to 20 db pads
 $\pm 1\%$ of value max. for 30 db pads and higher.
VSWR: DC: 1.02 max. DC to 1 Gc: 1.15 max. Gc to 3 Gc: 1.20 max.

SPECIFICATIONS

IMPEDANCE: 50 Ω
FREQUENCY RANGE: DC to 12.4 Gc.
STANDARD NOMINAL VALUES: 3, 6, 10 and 20 db.
MAXIMUM DEVIATION FROM NOMINAL VALUE (INCLUDING FREQUENCY SENSITIVITY):
 3 db: ± 0.3 db.
 6, 10 and 20 db: $\pm 5\%$ in db.
VSWR: DC to 4 Gc: 1.20 maximum.
 4 Gc to 12.4 Gc: 1.35 maximum.
POWER SENSITIVITY: < 0.001 db/db/Watt.
INPUT POWER: 1 Watt average maximum, 1 KW peak maximum.
TEMPERATURE COEFFICIENT: < 0.0001 db/db/ $^{\circ}$ C.
CALIBRATION FREQUENCIES (WITH INSERTION LOSS VALUES PERMANENTLY STAMPED ON NAME-PLATE): DC, 2, 4, 8, 10 and 12 Gc.
CONNECTORS: Type "N" Stainless Steel, male to female.
CONSTRUCTION: Stainless Steel Body.
LENGTH: 2.46" **DIAMETER:** $\frac{5}{8}$ "
WEIGHT: Net, 2 $\frac{1}{2}$ oz.; Shipping (Min.) 2 lbs.

*Patent No. 3,157,846

SPECIFICATIONS

IMPEDANCE: 50 Ω
FREQUENCY RANGE: DC to 18 Gc.
STANDARD NOMINAL VALUES: 10 and 20 db.
MAXIMUM DEVIATION FROM NOMINAL VALUE (INCLUDING FREQUENCY SENSITIVITY):
 10 and 20 db: $\pm 5\%$ in db.
VSWR: DC to 4 Gc: 1.2 maximum
 4 to 12.4 Gc: 1.35 maximum
 12.4 to 18 Gc: 1.50 maximum
POWER SENSITIVITY: < 0.001 db/db/Watt.

● MODEL 1, 2 . . . DC-18 Gc



Ψ MODEL 2

INPUT POWER: 1 Watt average maximum; 1 KW peak maximum.
TEMPERATURE COEFFICIENT: < 0.0001 db/db/ $^{\circ}$ C.
CALIBRATION FREQUENCIES (WITH INSERTION LOSS VALUES PERMANENTLY STAMPED ON NAME-PLATE): DC, 4, 8, 12, 16 and 18 Gc.
CONNECTORS: Type "N" Stainless Steel, male to female.
CONSTRUCTION: Stainless Steel Body.
LENGTH: 2.46" **DIAMETER:** $\frac{5}{8}$ "
WEIGHT: Net, 2 $\frac{1}{2}$ oz.; Shipping (Min.) 2 lbs.

● MODEL 50 . . . DC-3 Gc



Ψ MODEL 50

INPUT POWER: 1 Watt average maximum, 1 KW peak maximum.
CALIBRATION FREQUENCIES (WITH INSERTION LOSS VALUES PERMANENTLY STAMPED ON NAME-PLATE): Certificate giving insertion loss in 50 ohm system at DC, 1.0, 2.0 and 3.0 Gc. VSWR at 1.0, 2.0 and 3.0 Gc (See inside front cover).
CONNECTORS: Type "N" Stainless Steel, male to female. (Type "C" and "SC" also available).
CONSTRUCTION: Stainless Steel Body.
DIMENSIONS: (DETERMINED BY CONNECTORS AND ATTENUATION VALUE): Length $\frac{3}{4}$ to $\frac{4}{4}$ in.
 Diameter, $\frac{11}{16}$ to $\frac{13}{16}$ in.
WEIGHT: Net, 5-6 oz.; Shipping (Min.) 2 lbs.



FIXED COAXIAL ATTENUATORS



MODEL 10

MODEL 10 . . . DC-1.5 Gc

These Ψ attenuators consist of T-pad sections capable of handling from 10 to 35 Watts of input RF power. They are designed to dissipate their full rated power with negligible changes in characteristics. Their stability and accurate calibrations make them useful in extending the range of microwave measurements. They can also be used in isolating higher power RF generators.

SPECIFICATIONS

IMPEDANCE: 50 Ω

FREQUENCY RANGE: DC to 1.5 Gc (useful to 2.0 Gc)

STANDARD NOMINAL VALUES: 1 to 10 db in 1 db steps; 20 db.

POWER SENSITIVITY: 0.1 db/10 db maximum at 10 watt input (steady state at 20° C ambient).

CONNECTORS: Type N Stainless Steel, male to female.

CONSTRUCTION: Black anodized aluminum body.

VSWR: DC to 1.0 Gc: 1.15 maximum
1.0 to 1.5 Gc: 1.30 maximum

CALIBRATION FREQUENCIES (WITH INSERTION LOSS STAMPED DIRECTLY ON NAMEPLATE): Certificate giving insertion loss in 50 ohm system at DC, 0.5, 1.0 and 1.5 Gc. (See inside front cover).

DIMENSIONS: (Determined by attenuation values): Length, 5-3/8 to 6-13/16 in.
Diameter, 1-5/8 in.

WEIGHT: Net, 15-20 oz.; Shipping (Min.), 2 lbs.

NOMINAL ATTENUATION (db)	POWER INPUT		MAXIMUM DEVIATION OF INSERTION LOSS FROM NOMINAL	
	AVERAGE (WATTS)	PEAK (KW)	DC—1.0 Gc (db)	1.0—1.5 Gc (db)
1	35	10	0.2	0.5
2	18	10	0.2	0.5
3	15	10	0.2	0.5
4	12	10	0.2	0.5
5 to 10	10	10	0.2	0.5
20	10	10	0.5	1.0



MODEL 693

MODEL 693 . . . DC-1.5 Gc

The Ψ Model 693 attenuators are similar to the Model 10 units described above. However, the addition of black anodized aluminum cooling fins enable these attenuators to handle from 20 to 70 Watts average power. The accurate calibration data supplied with each unit makes the Model 693 useful in many precision applications.

SPECIFICATIONS

IMPEDANCE: 50 Ω

FREQUENCY RANGE: DC to 1.5 Gc (useful to 2.0 Gc)

STANDARD NOMINAL VALUES: 1 to 10 db in 1 db steps, 20 db.

POWER SENSITIVITY: 0.1 db/10 db at 20 watts input (steady state at 20° C ambient).

VSWR: DC to 1.0 Gc; 1.15 maximum.

1.0 Gc to 1.5 Gc: 1.30 maximum.

CONNECTORS: Type N Stainless Steel, male to female.

CONSTRUCTION: Black anodized aluminum body.

CALIBRATION FREQUENCIES (WITH INSERTION LOSS STAMPED DIRECTLY ON NAMEPLATE): Certificate giving insertion loss in 50 ohm system at DC, 0.5, 1.0 and 1.5 Gc VSWR at 0.5, 1.0 and 1.5 Gc. (See inside front cover).

DIMENSIONS: (Determined by attenuation values): Length, 5-11/16 to 6-13/16 in.
Width, 2-1/2 in.
Height, 2-1/2 in.

WEIGHT: Net, 24-28 oz.; Shipping (Min.), 2 lbs.

NOMINAL ATTENUATION (db)	POWER INPUT		MAXIMUM DEVIATION OF INSERTION LOSS FROM NOMINAL	
	AVERAGE (WATTS)	PEAK (KW)	DC—1.0 Gc (db)	1.0—1.5 Gc (db)
1	70		0.2	0.5
2	36		0.2	0.5
3	30	10	0.2	0.5
4	24	10	0.2	0.5
5 to 10	20	10	0.2	0.5
20	20	10	0.5	1.0

Most models available with other connector types.



FIXED COAXIAL ATTENUATORS

● MODEL 210 . . . 0.4-12.4 Gc

These broadband attenuators of the lossy line type are supplied with accurate calibrations which make them useful in precision applications such as extending the range of power meters, for calibrating the insertion loss of other components, and for simulating path losses. Because of their excellent match, they are also used as buffer attenuators on the load or generator sides of measuring systems.

The Model 210 attenuators are made from Ψ film resistive elements deposited on a special ceramic base. The finished resistors are artificially aged to give maximum stability. Because of the film used, these attenuators are capable of handling greater peak power than most units of this type.

SPECIFICATIONS

NOMINAL ATTEN- UATION (db)	FREQUENCY (Gc)	MAXIMUM VSWR	POWER INPUT		NOMINAL VALUE TOLERANCE (at 4 Gc)	MAXIMUM DEVIATION OF INSERTION LOSS FROM 4 Gc	
			AVERAGE (WATTS)	PEAK (KW)		At 1 Gc (db)	At 10 Gc (db)
1	0.4-12.4	1.25 to 10 Gc	5	10	± 0.1	-0.2	+0.2
2	0.5-12.4	1.25 to 10 Gc	5	10	± 0.1	-0.2	+0.2
3	0.6-12.4	1.25 to 10 Gc	5	10	± 0.1	-0.2	+0.2
4	1-12.4	1.25 to 10 Gc	4	8	± 0.1	-0.3	+0.3
5	1-12.4	1.25 to 10 Gc	3	6	± 0.1	-0.4	+0.3
6	1-12.4	1.25 to 10 Gc	3	6	± 0.1	-0.5	+0.3
7	1-12.4	1.35 to 2 Gc	2.5	5	± 0.1	-0.6	+0.4
8	1-12.4	1.30 to 10 Gc	1	1	± 0.1	-0.8	+0.5
		1.35 to 2 Gc					
9	1-12.4	1.30 to 10 Gc	1	1	± 0.1	-1.0	+0.5
		1.35 to 2 Gc					
10	1-12.4	1.30 to 10 Gc	1	1	± 0.1	-1.1	+0.5
		1.30 to 10 Gc					
20	2-12.4	1.35 to 3 Gc	1	1	± 0.2	-1.3*	+1.0
		1.30 to 10 Gc					

*At 2 Gc



Ψ MODEL 210

IMPEDANCE: 50 Ω

FREQUENCY RANGE: Determined by Attenuation Value.

CALIBRATION FREQUENCIES (WITH INSERTION LOSS VALUES STAMPED DIRECTLY ON NAMEPLATE): Certificate giving insertion loss in 50 ohm system at 1.0, 4.0 and 10.0 Gc for 1-10 db pads and at 2.0, 4.0 and 10.0 Gc for 20 db pads. VSWR for both connectors at same frequencies. (See inside front cover.)

CONNECTORS: Type "N" Stainless Steel, male to female (other combinations available).

CONSTRUCTION: Stainless Steel Body.

DIMENSIONS (Determined by connector combination):

Length, 8-1/8 to 8-3/8 in. Diameter, 5/8 to 25/32 in.

WEIGHT: Net, 8 oz.; Shipping (Min.), 2 lbs.

● MODEL 530A . . . 0.4-12.4 Gc

The Ψ Model 530A Attenuators are improved versions of the older Model 530. Use of a recently developed special microwave resistive film results in an extremely low temperature and power coefficient of attenuation. The 530A is ruggedized to meet the requirements of MIL-A-3933A and the high impact shock test requirement prescribed in MIL-T-945A.

Accurate insertion loss calibration data at 3 frequencies is permanently marked on the nameplate of each attenuator.

SPECIFICATIONS

NOMINAL ATTEN- UATION (db)	FREQUENCY (Gc)	MAXIMUM VSWR	POWER INPUT		NOMINAL VALUE TOLERANCE (at 4 Gc)	MAXIMUM DEVIATION OF INSERTION LOSS FROM 4 Gc	
			AVERAGE (WATTS)	PEAK (KW)		At 1 Gc (db)	At 10 Gc (db)
1	0.4-10	1.25	5	10	± 0.1	-0.2	+0.2
2	0.5-10	1.25	5	10	± 0.1	-0.2	+0.2
3	0.6-10	1.25	5	10	± 0.1	-0.2	+0.2
4	1-10	1.25	4	8	± 0.1	-0.3	+0.2
5	1-10	1.25	3	6	± 0.1	-0.4	+0.2
6	1-10	1.25	3	6	± 0.1	-0.4	+0.2
7	1-10	1.30-1 to 2 Gc	2.5	5	± 0.1	-0.6	+0.3
8	1-10	1.25-2 to 10 Gc	2	2	± 0.1	-0.8	+0.4
		1.30-1 to 2 Gc					
9	1-10	1.25-2 to 10 Gc	2	2	± 0.1	-0.8	+0.4
		1.30-1 to 2 Gc					
10	1-12.4	1.25-2 to 10 Gc	2	2	± 0.1	-0.8	+0.4
		1.30-1 to 2 Gc					
20	2-12.4	1.25-2 to 10 Gc	2	2	± 0.2	-0.9*	+0.4
		1.30-2 to 10 Gc					

*At 2 Gc



Ψ MODEL 530A

IMPEDANCE: 50 Ω

FREQUENCY RANGE: Determined by Attenuation Value.

POWER SENSITIVITY: <0.001 db/db/Watt.

TEMPERATURE COEFFICIENT:

1 to 5 db: <0.0003 db/db/°C.

6 to 20 db: <0.0001 db/db/°C.

CALIBRATION FREQUENCIES (WITH INSERTION LOSS VALUES STAMPED DIRECTLY ON NAMEPLATE): Certificate giving insertion loss in 50 ohm system at 1.0, 4.0 and 10.0 Gc for 1 to 10 db attenuators and at 2.0, 4.0 and 10.0 Gc for 20 db attenuators. VSWR at same frequencies. (See inside front cover.)

CONNECTORS: Type "N" Stainless Steel, male to female (other combinations available).

CONSTRUCTION: Stainless Steel Body.

DIMENSIONS (Determined by connector combination):

Length, 8-1/8 to 8-3/8 in. Diameter, 5/8 to 25/32 in.

WEIGHT: Net, 10 oz.; Shipping (Min.) 2 lbs.



FIXED COAXIAL ATTENUATORS

● MODELS 502 and 503 . . . 0.5-10 Gc

These attenuators are similar in construction to the Model 210 except that they are made up of multiple sections to increase their power handling capabilities. They will handle average powers up to 10 watts and peak powers up to 10 KW depending upon the attenuation value.

SPECIFICATIONS

MODEL NUMBER	NOMINAL ATTENUATION (db)	FREQUENCY RANGE (Gc)	MAXIMUM POWER INPUT		NOMINAL VALUE TOLERANCE (at 4 Gc)	MAXIMUM DEVIATION OF INSERTION LOSS FROM 4 Gc	
			AVERAGE (WATTS)	PEAK (KW)		At 1 Gc (db)	At 10 Gc (db)
502	3	0.5-10	10	10	±0.1	-0.4	+0.4
502	6	0.6-10	5	10	±0.1	-0.6	+0.4
502	10	1-10	5	10	±0.1	-0.9	+0.6
502	20	1-10	1	1	±0.2	-2.4	+1.4
503	6	0.6-10	10	10	±0.1	-0.4	+0.6
503	20	1-10	5	10	±0.2	-2.4	+1.3
503	24	1-10	3	6	±0.2	-2.8	+1.6
503	30	1-10	1	1	±0.2	-3.6	+2.1

☞ MODEL 502

IMPEDANCE: 50 Ω

FREQUENCY RANGE: Depends on Attenuation Value.

VSWR: 1.30 maximum.

CALIBRATION FREQUENCIES (WITH INSERTION LOSS VALUES STAMPED DIRECTLY ON NAMEPLATE): Certificate giving insertion loss in 50 ohm system at 1.0, 4.0 and 10.0 Gc. Input VSWR at same frequencies. (See inside front cover.)

CONNECTORS: Type "N" Stainless Steel, male to female.

CONSTRUCTION: Stainless Steel Body.

DIMENSIONS: Model 502, Length 15 in. Diameter 25/32 in.; Model 503, Length 21 3/4 in. Diameter 25/32 in.

WEIGHT: Model 502, Net, 13 oz.; Shipping (Min.), 2 lbs.; Model 503, Net, 18 oz.; Shipping (Min.), 3 lbs.

● MODEL 870 . . . 7-12.4 Gc

This unit incorporates a new design principle,* a resistive outer conductor which is closely coupled thermally to the heat dissipating shell. This construction enables the Model 870 to handle 20 watts average power in an active length of only 3 3/4 inches.

*Covered by U. S. Patent No. 3,002,166

SPECIFICATIONS

IMPEDANCE: 50 Ω

FREQUENCY RANGE: 7 to 12.4 Gc.

STANDARD NOMINAL VALUES: 1, 2, 3 and 6 db.

MAXIMUM DEVIATION FROM NOMINAL VALUE (INCLUDING FREQUENCY SENSITIVITY): 0.5 db.

VSWR: 1.30 maximum.

POWER SENSITIVITY: <0.05 db between 0 and 20 watts cw input.

INPUT POWER: 20 Watts average, 10 KW peak.

CALIBRATION FREQUENCIES (WITH INSERTION LOSS VALUES STAMPED DIRECTLY ON NAMEPLATE): Certificate giving insertion loss in 50 ohm system at 7.0, 9.0 and 11.0 Gc. VSWR at same frequencies. (See inside front cover.)

CONNECTORS: Type "N" Stainless Steel, male to female.

CONSTRUCTION: Stainless Steel Body.

DIMENSIONS:

Length, 4-15/16 in. Diameter, 1 in.
WEIGHT: Net, 10 oz.; Shipping (Min.), 2 lbs.



☞ MODEL 870

Most models available with other connector types.



ATTENUATION STANDARDS



MODEL AS-4

● MODEL AS-4 . . . DC-10 Gc

These attenuation standards are sets of eight specially selected and calibrated Ψ Precision Attenuators. They are ideally suited for standards and research laboratories as well as for reference standards in production, quality control, and inspection departments. With accurate calibrations every 1 Gc from DC to 10 Gc, these sets are useful in many precision applications. These include extending the range of microwave power measurements and in calibrating the insertion loss of other devices.

Each set contains a 3, 6, 10 and 20 db low frequency Ψ Model 50 and a 3, 6, 10 and 20 db high frequency Ψ Model 530A Attenuator. All are especially selected for low VSWR and other favorable characteristics. Like all Ψ Precision Attenuators, the Type "N" connectors and bodies are fabricated of stainless steel and all nameplates are color coded.

DC measurements are supplied with each attenuator. These measurements can easily be repeated in the laboratory and provide assurance that the RF characteristics of the attenuator are unchanged.

SPECIFICATIONS

ATTENUATOR MODEL NUMBER	NOMINAL ATTENUATION VALUES (db)	MODEL AS-4 CALIBRATION DATA SUPPLIED
50	3, 6, 10 & 20	DC Resistance Insertion Loss at DC 1.0, 2.0 and 3.0 Gc
530A	3, 6, 10 & 20	DC Resistance Insertion Loss at 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0 and 10 Gc

WEIGHT Shipping (Min.), 6 lbs.

CALIBRATION: A plastic laminated Certificate of Calibration is mounted inside of the walnut case and contains complete calibration data for each attenuator, including DC resistance. The stated accuracies are based on MAXIMUM POSSIBLE errors and not RMS. These maximum possible errors include, among others, the VSWR of the individual attenuator, source VSWR, load VSWR, system calibration accuracy, frequency and ambient temperature changes, and mechanical repeatability of connectors. The probable error is only a small fraction of this value. As an example of the accuracy to which these units are calibrated, sample values for the 20db pads in a typical AS-4 Set are shown below.

TYPICAL CALIBRATION ACCURACY FOR 20 db PADS IN MODEL AS-4

Frequency (Gc)	DC	1	2	3	4	5	6	7	8	9	10
Model 50 (db)	.01	.06	.08	.10	.12	.13	.14	.16	.17	.17	.16
Model 530A (db)				.11	.12	.13	.14	.16	.17	.17	.16

WEINSCHTEL ENGINEERING
Gaithersburg, Maryland

Certificate of Calibration

MODEL AS-4 PRECISION ATTENUATOR SET SERIAL NO. 335
Insertion Loss Measured in 50 Ohm System at 20° C ± 2° C

MODEL 50 ATTENUATORS

Serial Number	Nom. Value	DC Resistance In Ohms		DC	Insertion Loss db		
		Female To Male	Male To Ground		Source and Load VSWR:	Source and Load VSWR:	
					<1.03 1.0 KMC	<1.04 2.0 KMC	<1.03 3.0 KMC
C6286	3 db	17.06	149.88	149.86	3.00 ± .01	3.08 ± .04	3.14 ± .05
C6296	6 db	33.06	81.40	81.36	6.02 ± .01	6.06 ± .04	6.00 ± .08
C6306	10 db	52.24	61.12	61.31	10.03 ± .01	10.16 ± .04	10.08 ± .08
C6316	20 db	79.90	49.76	49.84	20.02 ± .01	20.07 ± .06	20.07 ± .10

MODEL 530A ATTENUATORS

Serial Number	Nom. Value	DC Resistance In Ohms		DC	Insertion Loss db		
		Female To Male	Male To Ground		Source and Load VSWR:	Source and Load VSWR:	
					<1.05 3.0 KMC	<1.06 4.0 KMC	<1.08 6.0 KMC
C6322	3 db	33.44	2.93 ± .08	2.97 ± .09	2.96 ± .10	3.02 ± .11	
C6332	6 db	69.24	5.99 ± .09	5.99 ± .09	6.09 ± .10	6.14 ± .11	
C6342	10 db	116.79	9.99 ± .09	10.03 ± .09	10.08 ± .11	10.08 ± .12	
C6352	20 db	236.97	19.83 ± .11	20.01 ± .12	20.10 ± .13	20.11 ± .14	

Date: Aug. 5, 1965 Test Engineer: G. F. Omy
Weinschel Eng. Job No. 118735 Chief Engineer: G. F. Omy

CALIBRATION STANDARDS AS APPLICABLE ARE TRACEABLE TO NATIONAL BUREAU STANDARDS 615-3/64



COAXIAL POWER DIVIDER AND TERMINATIONS

● MODEL 1506 . . . DC-10 Gc



Ψ MODEL 1506

The Ψ Model 1506 is calibrated, broadband coaxial power divider with two outputs balanced to within 0.35 db from DC to 10 Gc. Insertion loss between any two of the 3 interchangeable input and output ports is 6 db nominal. This small light weight unit is supplied with Type "N" stainless steel connectors and is capable of handling an input power of up to 1 watt average, 1 KW peak maximum. Calibrations are permanently marked on the nameplate of each unit at DC, 3, 6, and 10 Gc.

SPECIFICATIONS

IMPEDANCE: 50 Ohms.
FREQUENCY RANGE: DC to 10 Gc.
INSERTION LOSS (between input and one output arm): 6 db nominal (−0.2 db, +1.2 db maximum at 10 Gc).
VSWR: 1.25 maximum.
MAXIMUM ASYMMETRY OF POWER DIVISION: 0.2 db to 4 Gc; 0.35 to 10 Gc.
PHASE DIFFERENCE: 0° nominal between output arms.
INPUT POWER: 1 Watt average, 1 KW peak maximum.

CALIBRATION FREQUENCIES (WITH INSERTION LOSS VALUES STAMPED DIRECTLY ON NAMEPLATE):
 Certificate showing insertion loss and VSWR at DC, 3, 6 and 10 Gc is supplied with each unit.

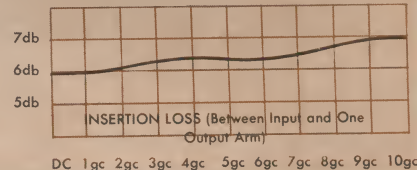
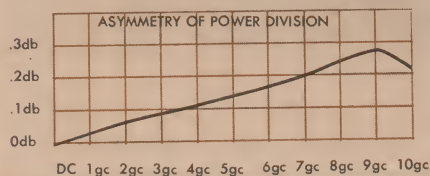
NUMBER OF PORTS: 3 useable interchangeably for input and output.

CONNECTORS: Type "N", Stainless Steel, 1 male (input), 2 female (output).

DIMENSIONS: 2.35" x 1.70" x 1.00".

WEIGHT: Net, 6 oz.; Shipping (Min.), 2 lbs.

TYPICAL CHARACTERISTICS MODEL 1506



● MODEL 535 TERMINATIONS . . . DC-12.4 Gc



Ψ MODEL 535 MN



Ψ MODEL 535FN

These exceptionally well matched, compact 50 ohm coaxial line terminations are useful in many precision applications. They are made with special Ψ film resistors which give maximum stability under peak pulse power and are capable of withstanding moderate short overloads without permanent damage. The rugged construction of these terminations makes them useful on the production line as well as in the laboratory.

SPECIFICATIONS

IMPEDANCE: 50 Ohms.
FREQUENCY RANGE: DC to 12.4 Gc.
INPUT POWER: 1 Watt average, 1 KW peak maximum.
TEMPERATURE COEFFICIENT OF RESISTOR: 0.03%/°C.
CALIBRATION DATA SUPPLIED: DC resistance. VSWR at 0.4, 1.0, 2.0, 7.5 and 10 Gc.
CONNECTORS: Type "N" Stainless Steel, male or female. Types "C", "SC", "BNC" and "TNC" are also available.

DIMENSIONS (Determined by connectors): Length, 1-11/16 to 1-1/4 in. Diameter, 5/8 to 25/32 in.
WEIGHT: Net 5 oz.; Shipping (Min.) 2 lbs.

MAXIMUM VSWR FOR TYPE "N" CONNECTORS:

MODEL NUMBER	DC-1 Gc	1-4 Gc	4-10 Gc
535MN	1.03	1.05	1.15
535FN	1.03	1.05	1.15

● MODEL 569A TERMINATION . . . DC-3 Gc

Ψ MODEL 569A



Most models available with other connector types.

The black anodized aluminum bodies with cooling fins and the special Ψ film resistors enable these terminations to handle powers up to 20 watts and still maintain their electrical characteristics. These environmentally stable models are optimized to satisfy the needs of particular systems, but similar models with different connectors, frequency ranges and power ratings are available on special order.

SPECIFICATIONS

IMPEDANCE: 50 Ω
FREQUENCY RANGE: DC to 3 Gc.
VSWR: DC to 0.5 Gc, 1.05 max.
 0.5 to 1.35 Gc, 1.08 max.
 1.35 to 3.0 Gc, 1.15 max.
INPUT POWER: 20 Watts average, 6 KW peak maximum.

OPERATING TEMPERATURE RANGE:
 −40°C to +75°C.

TEMPERATURE COEFFICIENT OF RESISTOR: 0.03%/°C.
CALIBRATION DATA SUPPLIED: DC resistance, VSWR at 0.4, 1.0, 2.0 and 3.0 Gc.

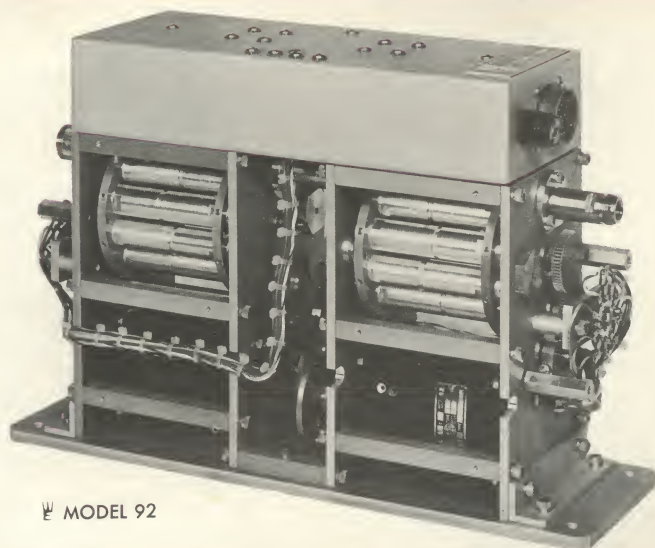
CONNECTOR: Type "N" Stainless Steel, male.

DIMENSIONS: Length, 4% in. Diameter, 1% in.

WEIGHT: Net, 12 oz.; Shipping (Min.), 2 lbs.



COAXIAL SLIDING SWITCH STEPATTENUATORS



MODEL 92

A newly developed slide action switch plus the new broadband attenuators have been combined for this new series of stepattenuators. Both manually operated and motor-driven programmable models are available in combinations up to 99db. These attenuators are in-line devices with fixed position input and output connectors. This allows direct insertion into a rigid coaxial system without the use of flexible cables or adaptors which normally introduce high VSWR and deteriorate the accuracy of the system especially at the higher frequencies. A minimum of moving parts and the use of self-cleaning and self-lubricating contact surfaces contribute to the long operating life of the sliding switch.

Calibration data is supplied with each unit at standard frequencies. Additional calibrations are available on request. Inquiries are also invited regarding applications.

MODELS 90, 91, 92 . . . DC-12 Gc

SPECIFICATIONS	MODEL 90 (MANUAL OPERATION)	MODEL 91 SINGLE DRUM MOTOR DRIVEN PROGRAMMABLE	MODEL 92 TWO DRUMS MOTOR DRIVEN PROGRAMMABLE
Impedance	50 Ω	50 Ω	50 Ω
Frequency Range	DC-12 Gc	DC-12 Gc	Model A92: 2 Gc-4 Gc Model B92: 4 Gc-8 Gc Model C92: 8 Gc-12 Gc
Maximum Deviation of Incremental Insertion Loss from Nominal Value	From DC to 12 Gc: $\pm 5\%$ in db or ± 1 db, whichever is greater	From DC to 12 Gc: $\pm 5\%$ in db or ± 1 db whichever is greater	0-5 db: $\pm .2$ db 6-9 db: $\pm .3$ db 10-99 db: $\pm .5$ db or $\pm 2\%$ whichever is greater
Insertion Loss Steps	10 db (Std. Unit)	10 db (Std. Unit)	0-9 db in 1 db steps 0-90 db in 10 db steps
Insertion Loss Range (Above Zero Position Loss)	0-60 db (Model 90-60) 0-90 db (Model 90-90)	0-90 db	0-99 db
Zero Position Insertion Loss	0.75 db max.	0.75 db max.	1 db max.
VSWR	1.50 max.	1.50 max.	1.75 max.
Input Power	1W Average, 1 KW Peak Max.	1W Average, 1 KW Peak Max.	1W Average, 1 KW Peak Max.
Connectors	Stainless Steel Type "N", male to female	Stainless Steel Type "N", male to female	Stainless Steel Type "N" male to female
Dimensions	Length, 7"; Height, 3 3/8", Width, 3 3/4"	Length, 8"; Height, 5 7/8", Width, 6 3/4"	Length, 13"; Height, 8-11/16"; Width, 4"
Weight: Net/Shipping	4 1/2 lbs./9 1/2 lbs.	11 lbs./16 lbs.	20 lbs./25 lbs.

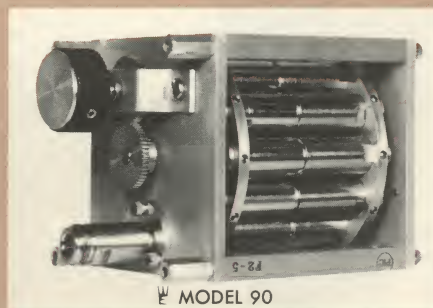
MODELS 91, 92 MOTOR DRIVEN PROGRAMMABLE

The motor driven units are designed for remote operation and are actuated by shorting to a common lead, the wire corresponding to the attenuation value desired. The drum then rotates and stops automatically at that position. Total switching time is less than 3 seconds. Although the unit requires 115 VAC to drive the motor, the actual control circuit operates at 6.3 VAC. Each unit is self-contained and requires no external relays, transformers, or power supplies. Switch life tests have exceeded 1,000,000 operations without degrading of the electrical special specifications.

MODEL 90, MANUALLY OPERATED

The Model 90 Stepattenuator offers the same high performance and long life as the motorized units. This simple operating, single knob control* unit is designed for convenient panel mounting and is ideal for use in systems or special purpose test equipment applications. The broadband DC to 12 Gc frequency range also makes these attenuators desirable for use in many of the new broadband instruments such as spectrum analyzers and signal generators. The use of the sliding switch eliminates both the time consuming push-pull operation of older types as well as the disadvantages of having the connectors actually move. Repeatability is in the order of 0.01 db. Because no cables are used, the '0' db insertion loss is very low.

*Approximately 4.5 lb. in. torque required to change db values in some versions



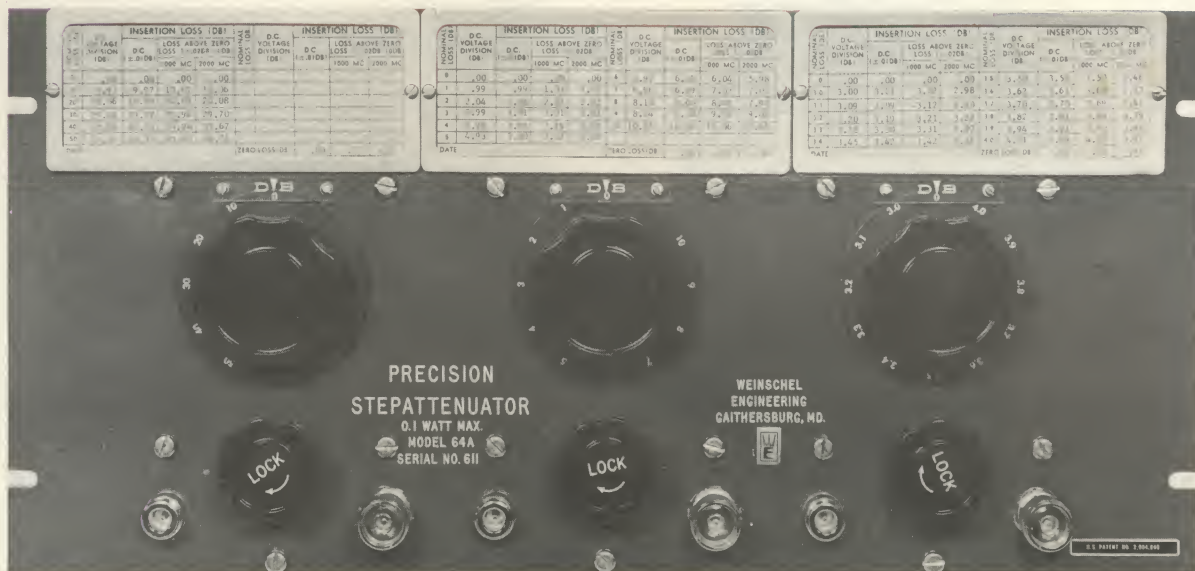
MODEL 90

PAT. NO. 3,157,846



COAXIAL STEP ATTENUATORS

● MODELS 60A THROUGH 64A . . . DC-2 Gc



MODEL 64A

These instruments, which consist of one or more drums of fixed pads, provide accurately calibrated incremental attenuation values in the range from 0 to 64 db in steps as small as 0.1 db. Accurate insertion loss, voltage division and VSWR test data are supplied with each unit, making it useful in many precision applications. For easy reference the insertion loss and voltage division data are laminated in plastic and mounted on the front panel.

All of the attenuators are made with  artificially aged film resistors which give maximum stability under peak pulse power and under temperature and humidity cycling. All drums use individually shielded, heavy duty, coaxial switches which will give many years of trouble free service even when subjected to continuous use in production set-ups.

SPECIFICATIONS

IMPEDANCE: 50 Ω

FREQUENCY RANGE: DC to 2 Gc (useful to 3.0 Gc in many non-critical applications).

MAX. INSERTION LOSS IN ZERO POSITION (Per Drum): At DC—0.005 db. At 1 Gc—0.4 db. At 2 Gc—0.5 Gc.

NOMINAL VALUE AT DC ACCURATE TO: 1 to 5 db—0.2 db. 6 to 10 db—0.05 db. 20 to 50 db—0.10 db.

MAX. CHANGE AT 2 Gc FROM DC VALUE OF INCREMENTAL INSERTION LOSS: 3.0-4.0, 0.05 db for each switch position. 0-10 db, 0.1 db for each switch position. 0-50 db, 0.1 db/10 db for each switch position.

MAX. VSWR (Bilateral): DC to 1 Gc—1.15. DC to 2 Gc—1.25.

MODEL—RANGE:

Model 60A—0 to 60 db in 1 db steps (Drums B and C)

Model 61A—0 to 10 db in 1 db steps (Drum B)

Model 62A—0 to 50 db in 10 db steps (Drum C)

Model 63A—0 to 4 db, 0 to 3 db in 1 step and 3 to 4 db in 0.1 db steps (Drum A)

Model 64A—0 to 64 db, 0 to 3 db in 1 db steps and 3 to 64 db in 0.1 db steps (Drums A, B and C).

ATTENUATION: All models consist of one or more of the following drums:

Drum A—0 to 3 db in one step; 3 to 4 db in 0.1 steps.

Drum B—0 to 10 db in 1 db steps.

Drum C—0 to 50 db in 10 db steps.

POWER INPUT (Bilateral): 100 milliwatts for max. accuracy. 1 Watt average and 1 KW peak with slightly reduced accuracy.

CALIBRATION ACCURACY:

At DC; Voltage division and insertion loss: ± 0.01 db up to 40 db, ± 0.02 db at 50 db.

At 1.0 and 2.0 Gc; Zero insertion loss: ± 0.01 db.

Incremental insertion loss: ± 0.2 db/10 db or 0.02 db, whichever is greater.

VSWR: 2%

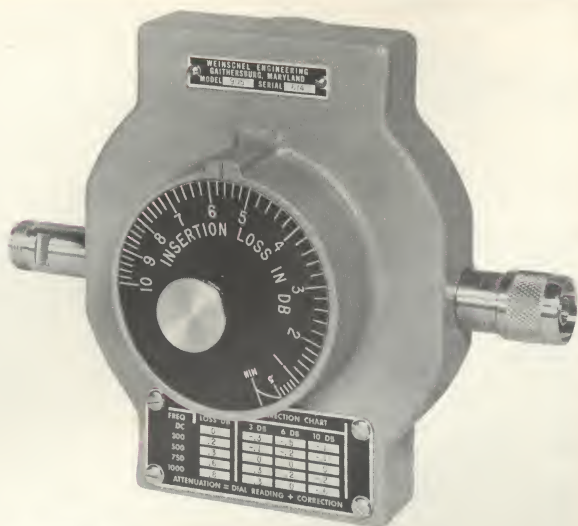
CONNECTORS: Type "N", one male and one female for each drum mounted stationary on front panel.

DIMENSIONS: Standard relay rack panel: Models 60A and 64A, 8 $\frac{3}{4}$ in. x 19 in. Models 61A, 62A and 63A, 8 $\frac{3}{4}$ in. x 7 in. Depth, 14 $\frac{3}{4}$ in. for all models.

SHIPPING WEIGHT: Model 60A, 45 lbs.; Models 61A, 62A and 63A, 34 lbs.; Model 64A, 64 lbs.



CONTINUOUSLY VARIABLE ATTENUATORS



W MODEL 905

PAT. NO. 3,184,694

IMPEDANCE: 50 Ω
FREQUENCY RANGE: DC to 1 Gc.
ATTENUATION RANGE: Variable to 10 db.
ZERO INSERTION LOSS: 0.8 db maximum (lower values are normal between DC and 0.5 Gc).
FREQUENCY SENSITIVITY (Difference between maximum and minimum insertion loss at any dial setting over entire frequency range): 1.0 db.
DIRECT READING DIAL ACCURACY (Including Resetability): 0.2 db.

MODEL 905 . . . DC-1 Gc

The Model 905 is a direct reading, continuously variable attenuator which provides up to 10 db of accurately calibrated attenuation over the frequency range from DC to 1 Gc. Typical applications include the extension of the range of power measurements, the setting of power levels and the measurement of gain, coupling and attenuation. The unit can be used for bench work or for panel mounting. Holes for panel mounting are behind the easily removable nameplate and correction chart.

Using the principle of a variable T-pad with optimum match over the entire range, the Model 905 employs high quality, stable, Ψ film resistor elements on a ceramic base. The mechanical design features an extremely smooth vernier drive with minimum backlash. Each Model 905 dial is calibrated individually for terminal to terminal insertion loss in db at the center frequency of 0.5 Gc. Small db correction factors for DC, 0.3, 0.75 and 1.0 Gc are permanently mounted on the front of the unit to allow a quick and reliable determination of true insertion loss over the entire range of frequency and attenuation. Model 905 can also be supplied as an uncalibrated level set attenuator (Model 905LS).

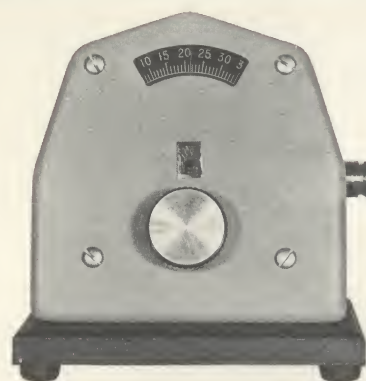
SPECIFICATIONS

INPUT VSWR: 1.50 maximum (lower values are normal between DC and 0.5 Gc).
POWER INPUT: 2 Watts Average, Maximum.
CALIBRATION DATA SUPPLIED: Insertion loss at DC, 0.3, 0.5, 0.75 and 1.0 Gc for 0, 3, 6, and 10 db points. Input and output VSWR.
CONNECTORS: Type "N" Stainless Steel, male to female.
DIMENSIONS: Length (including connectors), 6-15/16 in. Height, 5-1/2 in. Thickness, 2-7/8 in.
WEIGHT: Net, 2½ lbs.; Shipping (Min.), 4 lbs.

MODEL 933 . . . DC-1 Gc

The Ψ Model 933 operates in the frequency range between DC and 1 Gc and is useful over the extended range from DC to 3 Gc. Continuously variable over its 120 db calibrated attenuation range, the 933 has a dial resolution of 1 db per division. The broad frequency and attenuation range coupled with the very low minimum loss of 4 db maximum make the 933 extremely desirable in many applications, such as an output attenuator for a broadband signal generator. In some dual purpose applications a single bilateral 933 has been used as both an input and output attenuator on the same test set. The Model 933 comes complete with a laboratory stand. The unit is readily adaptable or may be purchased for panel mounting (Model 933P). The laboratory stand may be ordered separately (Model 933Z).

These attenuators are normally calibrated at 500 Mc. Calibrations at other frequencies can be supplied on special order. The Model 933, like all Ψ variable attenuators, is also available as an uncalibrated level set attenuator.



W MODEL 933

PAT. NO. 3,157,846

IMPEDANCE: 50 Ω
FREQUENCY RANGE: DC to 1 Gc (useful to 3 Gc).
ZERO INSERTION LOSS: 4 db maximum.
CALIBRATED ATTENUATION RANGE: 6 to 120 db.
FREQUENCY SENSITIVITY: 0.3 db or 1.5% (whichever is greater) to 1000 Mc.
DIRECT READING DIAL ACCURACY: 0.25 db or 0.4% (whichever is greater) at the calibration frequency.
ACCESSORIES: Model 933Z Stand.

SPECIFICATIONS

INPUT VSWR: At Minimum Loss, 2.3 maximum. Above 15 db, 1.15 maximum.
OUTPUT VSWR: At Minimum Loss, 2.3 maximum. Above 15 db, 1.3 maximum.
TEMPERATURE COEFFICIENT: Less than .5 db spread at 100 db over Temperature range from -20° to +150°F.
CONNECTORS: Type "N" Stainless Steel female, other connectors are available.
DIMENSIONS: Diameter 4-3/32". Depth (including input connector) 4-11/16".
WEIGHT: Net, 2½ lbs.; Shipping (Min.), 4 lbs.

Most models are available with other connector types.



CONTINUOUSLY VARIABLE ATTENUATORS



MODEL 953

MODEL 973

MODEL 953P

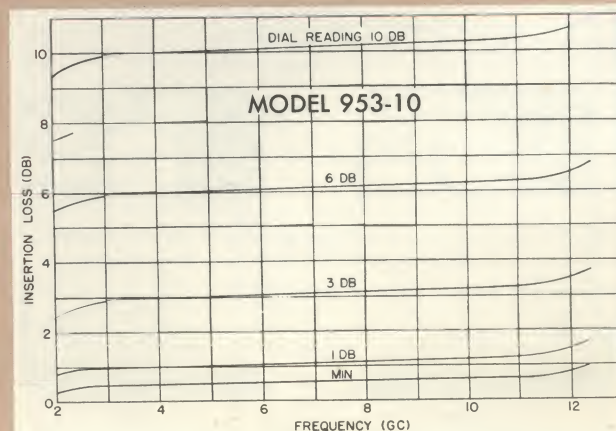
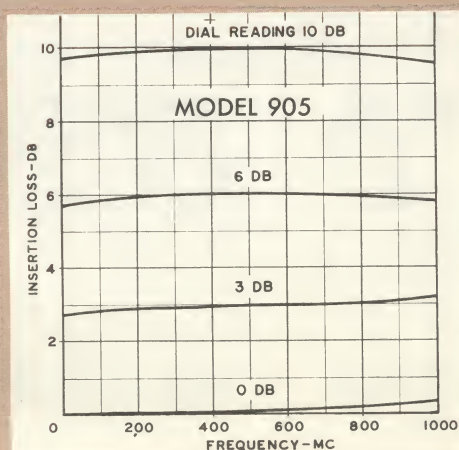
MODELS 953 AND 973 ... 1-11 Gc

The 953 and 973 models of variable attenuators are identical in operation but differ in frequency range and overall length. All models are extremely broadband covering a minimum frequency range of 4 to 11 Gc in the 20db and 40db versions to a maximum range of 1 to 11 Gc in the 3db unit (see chart below for model comparison). The direct reading dials are individually calibrated at a mid-frequency and a correction table for an upper and lower frequency is permanently attached.

All models are available in conventional or panel mounting configurations. Special models calibrated to 12.4 Gc are also available. As in the case with all variable attenuators, the 953 and 973 models can also be supplied as uncalibrated level set attenuators.

SPECIFICATIONS	MODEL 953-3 953P-3	MODEL 953-10 953P-10	MODEL 953-20 653P-20	MODEL 973-10 973P-10	MODEL 973-20 973P-20	MODEL 973-40 973P-40
Nominal Impedance	50 Ω	50 Ω	50 Ω	50 Ω	50 Ω	50 Ω
Frequency-Range	1.0 Gc-11 Gc	2.5 Gc-11 Gc	4 Gc-11 Gc	1.3 Gc-11 Gc	2.5 Gc-11 Gc	4 Gc-11 Gc
Attenuation Range	3 db	10 db	20 db	10 db	20 db	40 db
Insertion Loss	.7 db Max. at 4 Gc	.8 db Max. at 4 Gc	1.0 db Max. at 8 Gc	1.0 db Max. at 4 Gc	1.0 db Max. at 4 Gc	1.5 db Max. at 8 Gc
Accuracy of Calibration (Including resettability)	.1 db	.2 db	.3 db	.1 db	.2 db	.4 db
Max. Correction from Scale Value	$\pm .5$ db	$\pm .8$ db	± 1.0 db	+1.0 db -1.2 db	+1.2 db 1.0 db	+1.2 db -1.5 db
Resolution of Scale	$\sim .60$ inches/db	$\sim .25$ inches/db	$\sim .12$ inches/db	$\sim .5$ inches/db	$\sim .25$ inches/db	$\sim .12$ inches/db
Scale Increments	.2 db	.5 db	.5 db	.2 db	.5 db	.5 db
VSWR	1.50 Max.	1.50 Max.	1.50 Max.	1.50 Max.	1.50 Max.	1.50 Max.
Phase Shift With Attenuation	$\sim 1^\circ$ /db	$\sim 1^\circ$ /db	$\sim 1^\circ$ /db	$\sim 1^\circ$ /db	$\sim 1^\circ$ /db	$\sim 1^\circ$ /db
Max. Input Power When Properly Terminated	1W Av., 1KW Peak	1W Av., 1KW Peak	1W Av., 1KW Peak	1W Av., 1KW Peak	1W Av., 1KW Peak	1W Av., 1 KW Peak
Calibration & Test Data Supplied:						
a.) Direct reading scale calibrated at	4 Gc	4 Gc	8 Gc	4 Gc	4 Gc	8 Gc
b.) Insertion Loss Corrections—Settings	Min. 1, 2, 3, & 4 db settings	Min. 2, 4, 6 & 10 db settings	Min. 5, 10, 15 & 20 db settings	Min. 2, 4, 6, & 10 db settings	Min. 5, 10, 15 & 20 db settings	Min. 10, 20, 30, & 40 db settings
Over-All Length	8 1/4"	8 1/4"	8 1/4"	14"	14"	14"
Weight (Net/Shipping)	8 1/2 oz./2 lbs.	8 1/2 oz./2 lbs.	8 1/2 oz./2 lbs.	1 lb./2 lbs.	1 lb./2 lbs.	1 lb./2 lbs.

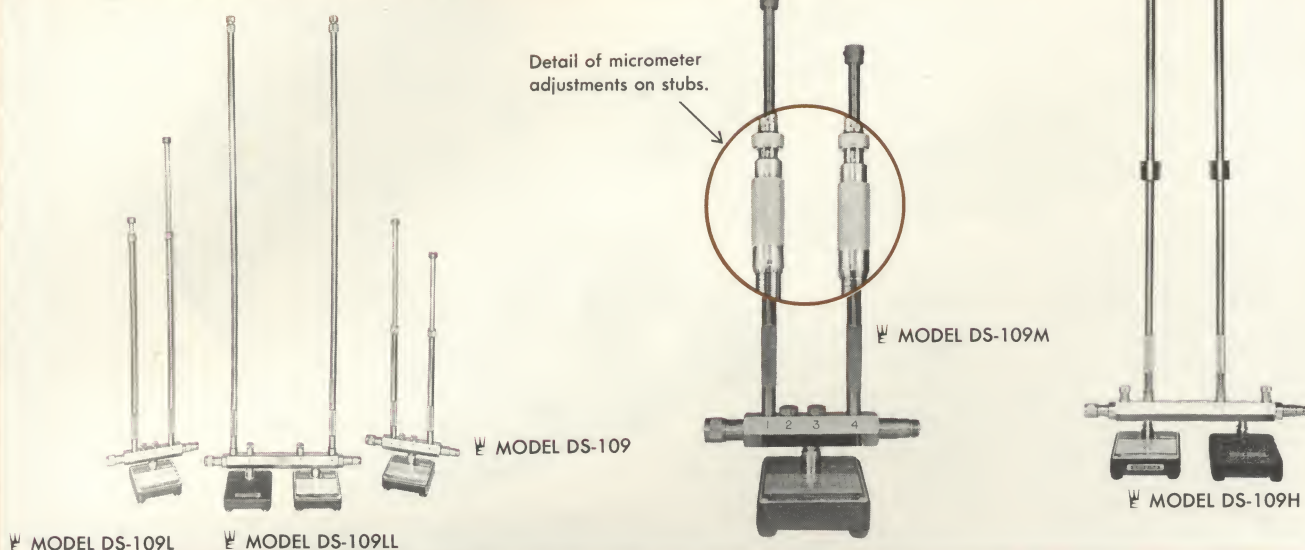
TYPICAL FREQUENCY RESPONSE OF INSERTION LOSS





TEST ACCESSORIES

● DOUBLE STUB TUNERS



The tuners in the DS-109 Series are variable RF impedance transformers. To provide matching capability over a greater range, all models have four positions at which the stubs can be inserted in the line. Each tuner is supplied with a permanently mounted instruction plate showing the preferred stub position for rapid convergence to a match in a particular frequency range. Careful attention to the design and construction of the sliding contacts result in a unit with greatly reduced noise when the short is in motion. Collet type locks prevent accidental movement of the stubs after they have been adjusted.

The Models DS-109, 109L and 109LL are useful in the range between 0.2 and 12.4 Gc. They are rugged, precise units which can be used in the laboratory or on the production line.

The Model DS-109M is similar in construction to the Model DS-109, but incorporates two resettable adjustments on each stub. Circumferential grooves provide a fast and accurate course setting. This adjustment is locked using a sliding collet. A micrometer type control is then used for fine tuning. Settings made in this manner can be repeated within a range of 0.005 inch. This instrument is useful over the frequency range from 0.75 to 12.4 Gc.

The Model DS-109H is designed for use over the frequency range from 40 to 400 Mc. This unit utilizes a helical conductor in both the stubs and the body between the stubs, giving the tuner an electrical length much greater than its mechanical length.

SPECIFICATIONS

LINE IMPEDANCE: 50 ohms for all models.

IMPEDANCE MATCH: All models will match to a 50 ohm line any impedance less than 50 ohms and any impedance more than 50 ohms resulting in a VSWR of less than 7.0.

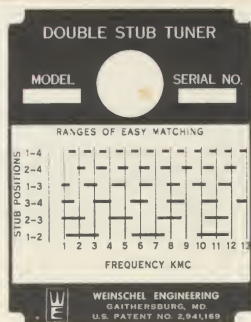
CONNECTORS: Type "N" Stainless Steel, one male and one female.

WEIGHT: Shipping (Min.); DS-109, 7 lbs.; DS-109L, 12 lbs.; DS-109LL, 16 lbs.; DS-109H, 16 lbs.; DS-109M, 7 lbs.

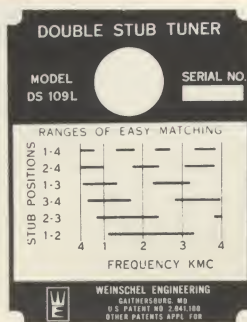
MODEL NUMBER	FREQUENCY RANGE	LENGTH OF STUB TRAVEL (cm)	OVERALL HEIGHT (in.)	OVERALL LENGTH (in.)
DS-109H	40—400 Mc	53	25 $\frac{1}{8}$ —48 $\frac{3}{4}$	12
DS-109LL	0.2—2 Gc	76	36 $\frac{1}{4}$ —66 $\frac{1}{2}$	12
DS-109L	0.4—4 Gc	38	20 $\frac{1}{2}$ —35 $\frac{3}{4}$	6 $\frac{1}{8}$
DS-109	0.75—12.4 Gc	20.5	12 $\frac{1}{2}$ —20 $\frac{3}{4}$	6 $\frac{1}{8}$
DS-109M	0.75—12.4 Gc	20.5	12 $\frac{1}{2}$ —20 $\frac{3}{4}$	6 $\frac{1}{8}$

U.S. PAT. NO. 2,941,169

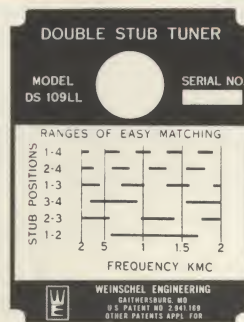
SAMPLE NAMEPLATES



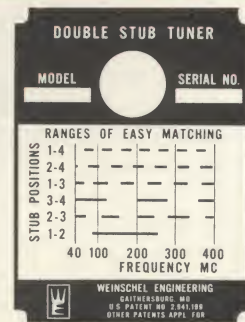
DS-109



DS-109L



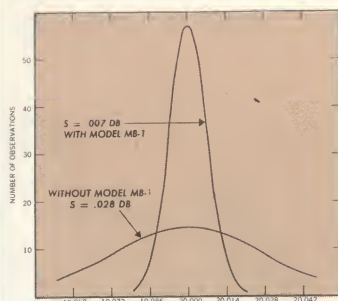
DS-109LL



DS-109H

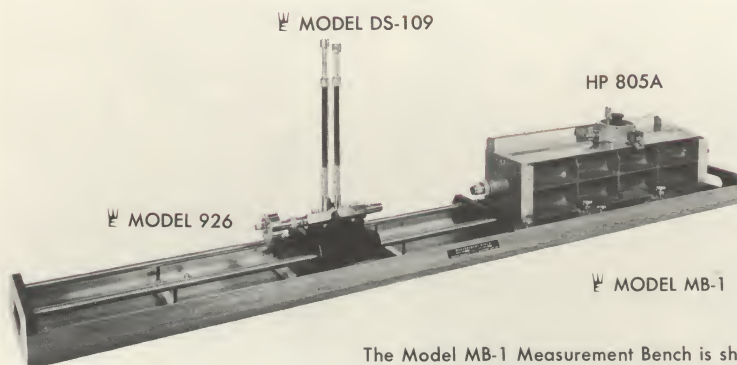


TEST ACCESSORIES



The curves above show the dramatic improvement in measurement repeatability which can be obtained with the MB-1. In this instance, insertion loss measurements were made of a 20 db attenuator at 4 Gc. A sampling distribution of measurements made with the MB-1 indicates a standard deviation of 0.007 db. A sampling distribution of measurements made without the MB-1 indicates a standard deviation of 0.028 db or 4 times as great.

● MODEL MB-1 MEASUREMENT BENCH



The Model MB-1 Measurement Bench is shown in use with the Weinschel Model DS-109 Double Stub Tuner, the Weinschel Model 926 Barretter Mount with integral noise suppressor and the Hewlett-Packard Model HP 805A Slotted Line.

The  Measurement Bench was designed to increase the accuracy of measurement in the  Insertion Loss Measuring Systems by providing a repeatable measurement axis, and by proper support and alignment of the microwave components at the "Insertion Point."

The MB-1 can be used for any laboratory or production application where many similar in-line coaxial devices must be inserted into a measurement setup with precise alignment and repeatability.

The Model MB-1 is equipped to accommodate most commercial slab type slotted lines and universal probe carriages.

SPECIFICATIONS

LENGTH OF TRAVEL OF TUNER MOUNT: Over 26 inches.

ALIGNMENT OF GUIDE RODS ALONG MEASUREMENT AXIS:

Assembly tolerance of 0.001 inch; negligible deviation during operation.

CLAMPS: Fast acting swivel or thumb screw type.

MOUNTING: 4 shock absorbing rubber feet.

OVERALL LENGTH: 5 feet.

OVERALL WIDTH: 8 3/4 inches.

HEIGHT AT TUNER MOUNT: 5 inches.

WEIGHT: Shipping (Min.) 42 lb.

● MODEL 1000R PRECISION SLOTTED LINE . . . 0.5-6 Gc



The  1000R Slotted Line features a low residual VSWR and slope. Slope and irregularities—two sources of error that cannot be tuned out—are held to exceptional low values by a unique combination of precision ball bearing carriage support and horizontal probe mounting. The latter overcomes the effects of sag in the center conductor.

The line is fitted with a stainless steel type "N" female connector on the input end and a GR type 900 connector on the output. Adapters from the GR type 900 to either male or female type "N" (Stainless Steel) are available as accessories. Other connector types are available on request.

The Model 1000R is also used in the  Precision Tunable Impedance Measuring System, Model 1050, which is described on Page 25 of this catalog.

SPECIFICATIONS

IMPEDANCE: 50 Ω

FREQUENCY RANGE: 500 Mc to 6 Gc.

RESIDUAL VSWR: 1.015 to 4 Gc, 1.04 to 6 Gc.

SLOPE AND IRREGULARITIES: 1.003 maximum (equivalent VSWR).

PROBE TRAVEL: 15.5 inches.

DETECTOR PROBE: Tunable over entire frequency range.

DETECTOR ELEMENT: 1N21 Crystal (supplied), or any detector with a similar size case.

CONNECTORS: Output: General Radio Type 900. Input: Type "N" female.

DIMENSIONS (LxHxW): 27 3/4"x7"x6".

WEIGHT: Net, 20 lbs.; Shipping (Min.), 30 lbs.



TEST ACCESSORIES

MODEL 926 BARRETTTER MOUNT WITH NOISE SUPPRESSOR

The Model 926 Barretter Mount with integral Noise Suppressor is a broadband fixed-tuned coaxial detector mount. Together with the  Model 943 Barretter Element the Model 926 is used as a square law detector for making precision insertion loss and R.F. power ratio measurements. The built in noise suppressor isolates the mount from commonly found system audio ground currents thus increasing the reliability and accuracy of the measurements. The 926 is recommended for use in both the  Single and Dual Channel Insertion Loss Measuring Systems,* the  Microwave Phase Bridge, and with the Model 1800 Stabilized SWR Indicator. The 926 is useable over the coaxial frequency range from 50 Mc to 12.4 Gc.

*Send for  Application Notes 1 and 4.

MODEL 943 BARRETTTER ELEMENT: The  Model 943 Barretter Element is especially designed for use with the  Model 926 Barretter Mount with Noise Suppressor. Bias Current for the 943 is 4.5MA nominal for 200 ohm DC resistance.

SPECIFICATIONS

IMPEDANCE: 50 Ω

FREQUENCY RANGE AND VSWR: From 50 Mc to 11.0 Gc, VSWR is 1.45 maximum. From 11.0 Gc to 12.4 Gc, VSWR is 1.75 maximum.

BARRETTTER ELEMENT: Weinschel Engineering Model 943, one supplied. 4.5 ma nominal current for 200 Ω dc resistance.

CONNECTORS:

RF Connector: Type "N" Female (Stainless Steel). **DC-Audio Connector:** BNC Female.

DIMENSIONS: Length, 3 1/2" (Maximum overall length). Width, 2 1/4".

WEIGHT: Net, 10 oz. Shipping, 1 1/2 lbs.



 MODEL 926

MODELS 936N and 936X NOISE SUPPRESSORS

These Noise Suppressors are RF transmission line components that almost completely eliminate audio ground currents and thus block extraneous signals from the detector. Audio ground currents can cause large errors in insertion loss measuring systems where low level signals must be accurately measured. For greatest measurement accuracy it is recommended that these rugged low leakage suppressors be used in every critical measurement system.

SPECIFICATIONS

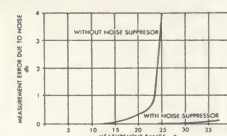
	936N	936X
FREQUENCY RANGE	10 Mc to 12.4 Gc	8.2 to 12.4 Gc
VSWR	1.5 Maximum	1.1 Maximum
INSERTION LOSS	1.0 db Maximum	0.2 db Maximum
LINE	3/4" coaxial	waveguide WR-90
CONNECTORS	Type "N" Stainless Steel, one male and one female	UG-39
LENGTH	2-29/32 in.	1 1/4 in.
DIAMETER	2 1/4 in.	1 1/4 in.
SHIPPING WEIGHT	2 lbs. (Min.)	2 lbs. (Min.)



 MODEL 936N



 MODEL 936X



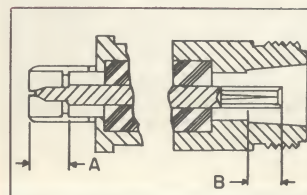
An example of the effectiveness of the Model 936 Noise Suppressors in Single Channel Attenuation Measurements.

COAXIAL CONNECTOR GAGE SETS GS-1, GS-3, GS-4, GS-5

 has designed a series of coaxial connector gage sets for checking the actual mating dimensions of male and female connectors to assure non-destructive mating. The drawing shows the dimensions measured on Type "N" connectors (A and B) by Gage Set Model GS-1. Each set contains a dial indicator, a series of adapters for the dial indicator, and a calibration gage block, accurate to ± 0.0002 inch, that is used to zero the indicator. Once set, the indicator shows the deviation from the nominal dimensions. These sets are very useful in the laboratory, production, quality control, incoming inspection, and many other areas where connectors are used. Gage Sets are available for checking Type "N", C, SC, HN, TNC, and BNC connectors. Only the calibration gage block need be changed if there are revisions to applicable specifications. **SHIPPING WEIGHT:** 4 lbs. (min.)



 MODEL GS-1



MODEL NO.	GS-1	GS-3	GS-4	GS-5
Connector Type	"N"	C SC	HN	BNC TNC



COAXIAL CONNECTORS

● MODEL 1500 STAINLESS STEEL TYPE "N" CABLE CONNECTORS



These ♂ Model 1500 Stainless Steel Cable Connectors for flexible cable conform to the dimensions and tolerances of military types UG-1185A/U and UG-1186A/U (Type "N") connectors and for RG-8/U and similar cable. The contacts of both the male and female connectors are captivated to prevent movement of the center conductor and damage to mating connectors. Use of these connectors increases the effective life of cable assemblies by reducing thread wear, chips, corrosion, and peeling plating that are common with brass connectors.

The shells of both jack and plug connectors are made of passivated type 303 stainless steel. The inner conductor of the jack is silver plated beryllium copper and the inner conductor of the plug is silver plated brass.

FEATURES

- **STAINLESS STEEL-INCREASED LIFE:** Stainless Steel connectors increase the effective life of cable assemblies by reducing problems of thread wear, chips, corrosion and peeling plating that are common with commercial brass connectors.
- **CONFORM TO MILITARY REQUIREMENTS:** These connectors are built in accordance with the dimensions and tolerances of military types UG-1185A/U and UG-1186A/U (Type N).
- **GUARANTEED UNIFORMITY:** 100% incoming inspection of all connector component parts, assures complete uniformity and quality in appearance.
- **INCREASED RELIABILITY:** Captivated contacts prevent the center conductor from moving.
- **SHIPPING WEIGHT:** 2 lbs. (min.)



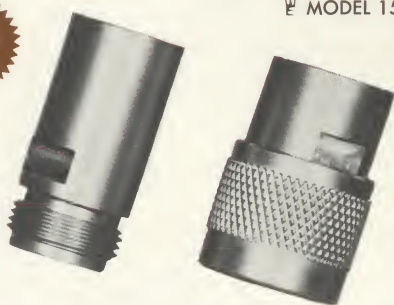
MODEL MI503N CABLE ASSEMBLIES

Complete Type RG-9/U cable assemblies are available with ♂ Model 1500NM male stainless steel connectors on each end. Standard assemblies are available in 2, 4, and 6 foot lengths with special lengths and connector configurations available on request.

● DC-18 Gc TYPE "N" CONNECTORS MODELS 1509, 1510, 1511, 1512

♂ MODEL 1510M

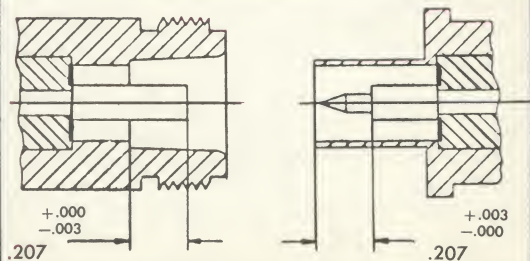
NEW



♂ has developed a new extended frequency range semi-precision modified Type "N" connector.* This connector extends the useful frequency range of coax components and systems to 18 Gc. One of the major advantages of this connector is that it mates with all military Type "N" connectors. This means that older equipment is not made obsolete and that adapters are not required. In some cases older equipment can be updated and the frequency range extended by replacing the older fittings with new ♂ connectors. Construction of these connectors is such that a damaged connector can be replaced by simply unscrewing the bad connector and replacing it with a new one. Male and female connectors are also interchangeable on the line or component since the mating configuration on the back of the connectors are the same including plug-in center conductors. These connectors also feature a low VSWR up to 18 Gc and are fabricated of stainless steel for long life.

The Model 1509 and 1510 are designed to be attached to components made in 7mm 50 ohm airline. The 1509 has an outside thread for mating to the line while the 1510 has an internal thread. The 1511 and 1512 have fittings for mechanical attachment to aluminum or copper solid jacketed semi-rigid coaxial cable such as UT 141. The 1511 is designed for .250" OD cable and the 1512 for .141" OD cable.

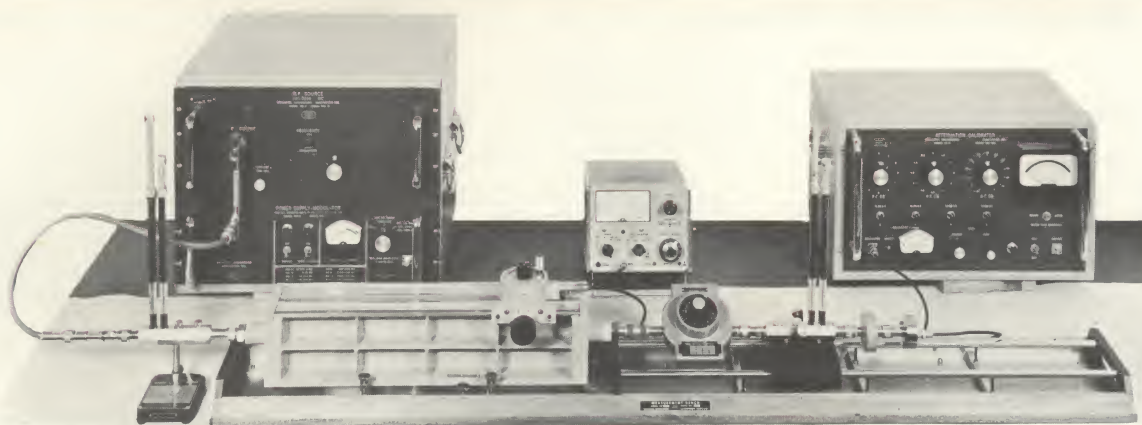
SHIPPING WEIGHT: 2 lbs. (min.)



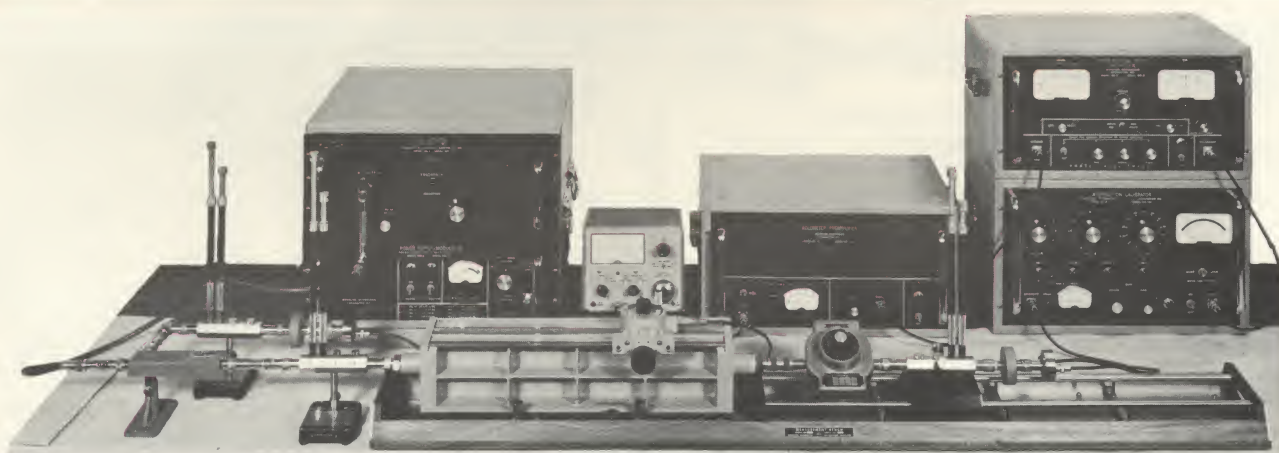
*PAT. APPL. FOR



INSERTION LOSS MEASUREMENTS



● SINGLE CHANNEL INSERTION LOSS MEASUREMENT SYSTEM



● DUAL CHANNEL INSERTION LOSS MEASUREMENT SYSTEM

The Ψ line of precision insertion loss measuring equipment offers a wide choice of instruments designed to meet any requirement from the routine production line measurement to the most exacting requirement of the standards laboratory. Selection of the most desirable system may be based on dynamic range, accuracy, or a combination of both. Consideration may also be given to initial cost and future requirements. Ψ Insertion Loss Measuring Systems differ not only in range and accuracy but also in the basic method of measurement. Some systems use the AF substitution technique while others utilize the IF Substitution technique.

The Audio Substitution method uses audio attenuators as a substitution standard. The Ψ Model 1800 Stabilized SWR Indicator, while not designed specifically for making insertion loss measurements, may be used for this purpose. The 1800 has a capability of measuring up to 35 db but the accuracy depends on the linearity of the amplifier and meter, and accuracy of the internal resistive voltage divider which is the audio attenuating device. All other Ψ insertion loss measuring instruments use precision wirewound "T" network attenuators preceding the amplifier and are independent of amplifier and meter linearity, which greatly increases their accuracy. The specific instruments are the Ψ Model BA-5 Attenuation Calibrator and the new solid-state Model 1801

Stabilized Attenuation Calibrator. These instruments are capable of making power ratio measurements up to 35 db in one step with an accuracy as great as ± 0.02 db per 10 db. When used in a Single Channel Insertion Loss Measuring System (see Block Diagram), the BA-5 system accuracy is typically ± 0.1 db per 10 db and the 1801, ± 0.05 db per 10 db. This deterioration in accuracy from ± 0.02 db/10 db is due to imperfect external accessories and includes such uncertainties as connector repeatability, mismatch errors, etc. RF source level changes which result in a direct measurement error in the BA-5 are compensated for in the 1801 by the AGC stabilization feature. This major error may also be compensated for in the BA-5 if used in a Dual Channel Insertion Loss System (see Block Diagram) and the ± 0.02 db per 10 db accuracy approached.

The IF Substitution method uses as a substitution standard a precision waveguide below cutoff attenuator. The IF instruments described here are the Model VM-1E Standard Attenuator Comparator and the Model VM-3 Attenuator and Signal Calibrator. While the accuracy and resolution of the IF systems are equal to or better than the AF Dual Channel System, the real advantage is in dynamic range. Both the VM-1 and VM-3 are capable of measuring up to 100 db in one step (see Block Diagram).

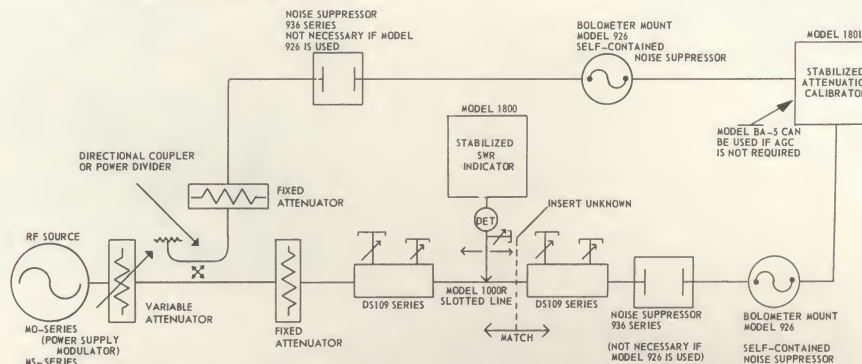


AUDIO SUBSTITUTION SYSTEMS

TYPICAL MEASURING SYSTEMS USING EQUIPMENT DESCRIBED IN THIS SECTION. INSERTION LOSS MEASUREMENTS

RANGE - 35 db (55 db with partial RF substitution).

FEATURES - Automatic Gain Control.



SINGLE CHANNEL AUDIO SUBSTITUTION SYSTEM WITH AGC

SINGLE CHANNEL: (See Block Diagram)—Over the past ten years, the Model BA-5 has been the basic single channel instrument and has found universal acceptance as an attenuation measuring standard. The Single Channel System, including the BA-5 and recommended accessories, is described in detail in Weinschel Application Note No. 1, which is available upon request. Interchangeable with the BA-5 in the single channel system is the new solid-state Model 1801 stabilized Attenuation Calibrator. The 1801 uses the identical precision wirewound "T" network audio attenuators as does the BA-5, but offers an improved accuracy due to a built in

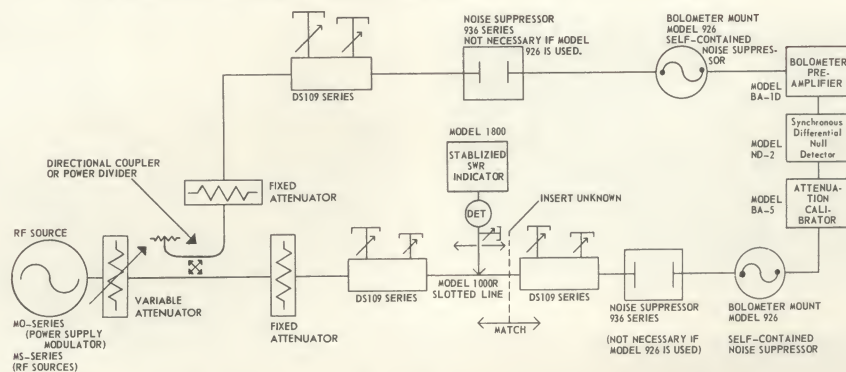
AGC circuit which compensates for RF source level changes. For less accurate measurements the Model 1800 may also be used. Similar to the 1801, the Model 1800 is a highly sensitive stabilized SWR indicator with AGC but without the precision audio attenuators preceding the amplifier. This instrument is described in detail on page 26.

For those applications that require approximately the same range (35db), but greater accuracy and resolution, we recommend the Weinschel Dual Channel Insertion Loss Measurement System.

INSERTION LOSS MEASUREMENTS

RANGE - 35 db (55 db with partial RF substitution).

FEATURES - Very high resolution, high accuracy in 0.001 to 1 db range.



DUAL CHANNEL AUDIO SUBSTITUTION SYSTEM

DUAL CHANNEL: The Dual Channel System, as can be seen in the Block Diagram, is an expansion of the Single Channel System. The basic measuring instrument in the dual channel is the BA-5, which allows the user to begin with the Single Channel System and as his accuracy requirements increase, convert the Single Channel to a Dual Channel System without obsolescence. All that is required is an additional Model 926 Barretter Mount, Model BA-1 Bolometer Preamplifier, and Model ND-2 Differential Null Detector. This additional instrumentation increases the system's accuracy from approximately ± 0.1 db per 10db in the Single Channel to ± 0.02 db per 10db in the Dual Channel with a resolution of 0.002db per division on the Model ND-2, Null Indicator. This is a typical accuracy, dependent upon external accessories. A major application for the Dual Channel system is in the accurate

measurement of small R.F. Power Ratios of 1db or less where the influence of amplitude variations from the R.F. Source must be eliminated. The Dual Channel automatically compensates for these amplitude changes. The 35db range of both Single and Dual Channel Systems can be extended up to 55db using partial R.F. Substitution, providing the R.F. Source being used has at least 200 milliwatts of R.F. power available. The Dual Channel System, including recommended accessories, is described in detail in Weinschel Application Note No. 4, which is available upon request. The Dual Channel System can also be used in making precision microwave phase shift measurements (see page 25).

The Audio Systems are limited in frequency range only by the availability of accessory components. The normal range is between 100Kc and 90Gc.



AUDIO SUBSTITUTION INSTRUMENTS

● MODEL BA-5 ATTENUATION CALIBRATOR

The Model BA-5 Attenuation Calibrator was specifically designed for making precision microwave attenuation measurements using the audio substitution technique. Since this technique requires the use of square law detectors, the instrument is calibrated directly in R.F. Attenuation. The unit contains an internal precision 2000 ohm audio attenuator which is placed in front of a low noise, high gain, 1000 cps tuned amplifier. This arrangement eliminates errors due to non-linearity of the amplifier since the level remains fixed during any one measurement.

The attenuator is continuously variable over a range of 52db R.F. with a resolution of 0.002db, and is accurate to ± 0.02 db for any setting up to 30 db. Although intended primarily for use with barretters, the BA-5 can also be used with crystals.

Other features of the BA-5 are a metered, internal-regulated constant-current bolometer bias supply, protective circuits to prevent barretter burnout while connecting or disconnecting the barretter or turning the instrument on or off, and a large mirror-backed meter, calibrated in db and VSWR which provides an indication of the detected output of the amplifier. The undetected output of the amplifier, fed through a cathode follower, is also available at the front panel.



MODEL BA-5

SPECIFICATIONS

ATTENUATORS:

Range: 0 to 52 db, continuously variable.

Complement: Four 10 db steps. One 0-10 db in 1 db steps. One 0, 1-2 db in 0.1 db steps. One -0.01 to +0.11 db continuously variable.

Accuracy: Less than 0.02 db error over a 30 db range.

Resolution: 0.002 db.

Input Impedance: 2000 ohms approximately.

AMPLIFIER:

Tuned Frequency: 1000 ± 3 cps.

Band Width: 35 cps maximum to the 3 db points.

Gain Stability: For line voltage from 105-125 V, $< \pm 0.1$ db RF equivalent.

EQUIVALENT NOISE: Less than 30 milli-microvolts.

BOLOMETER BIAS: 0, 3-9 ma, barretter protection circuit.

OUTPUT METER: $4\frac{1}{2}$ " mirror-backed scale with db and VSWR calibration. The db scale is accurate to ± 0.05 db from 0-5 db.

OUTPUT JACK: 1.5 V maximum, 250 ohms source impedance.

POWER: 115V, 50/60 cps, 190 VA approximately.

DIMENSIONS: Rack panel, $10\frac{1}{2}$ " x 19". Depth 13".

WEIGHT: Net 35 lbs. Shipping 50 lbs.

NEW

● MODEL 1801 STABILIZED ATTENUATION CALIBRATOR



MODEL 1801

The Model 1801 combines the best features of the BA-5 and the new Model 1800 Stabilized SWR Indicator in a single, compact, versatile, solid-state instrument. The precision audio attenuators, bolometer burnout protection, and circuit arrangement for eliminating measurement errors due to amplifier non-linearity, were taken from the BA-5. The 1800 contributed the AGC circuit to compensate for amplitude variations in the R.F. Source plus the 0.02db resolution of the expanded range scale. The resulting instrument is capable of making insertion loss measurements over a range of 35db to an accuracy of ± 0.05 db per 10 db. If less accurate measurements are sufficient, the 50db (10db steps) internal calibrated voltage divider and meter scale 10:1 power ratio range may be used. The instrument also doubles as a high resolution stabilized SWR indicator with an expanded VSWR scale of 1.06 (0.5db R.F.).

The Model 1801 also features a variable center frequency and bandwidth for greater sensitivity, solid-state amplifier and power supply, and a low impedance amplifier AC output for driving an external indicator. If an external recorder is used, a DC output is also available through a phone jack. The 1801 can be operated from an optional battery pack (Model 1800Z) and contains a built in trickle charger.

SPECIFICATIONS

	SIGNAL AMPLIFIER	AGC AMPLIFIER
FREQUENCY	1000 cps adjustable ± 20 cps	Broadband
BANDWIDTH	Adjustable 30 to 100 cps approx.	
RF DETECTORS	Square law crystal or barretter	Square law crystal or barretter
BARRETTTER BIAS	3.0-9 ma constant current source with full barretter burnout protection	3.0-9 ma constant current source with full barretter burnout protection
REGULATION		± 0.03 db RF meter change for ± 1 db RF change in RF level
AGC TIME CONSTANT		.2 sec. (nominal)

CALIBRATED METER AND SWITCH:

Operating Modes: Normal; Four 2.5 db Expand; One 0.5 db Expand (1.06).

Voltage Gain: 5×10^6 nominal—0.3 μ V signal for full scale deflection.

AUDIO SUBSTITUTION ATTENUATOR:

Steps: Four 10 db steps, Ten 1 db steps. Ten 0.1 db steps. Continuous 0.1 db marked every 0.01 db.

Accuracy: < 0.02 db error over a 30 db range.

Resolution: 0.002 db.

Primary Power: 105-125/210-250V; 50/60 cps; 30 VA.

Equivalent Noise: < 0.03 μ V (rms) referred to input with 200 Ω resistor simulating barretter.

WEIGHT: Net, 20 lbs.; Shipping (Min.) 27 lbs.



AUDIO SUBSTITUTION INSTRUMENTS

● MODEL ND-2 SYNCHRONOUS DIFFERENTIAL NULL DETECTOR



MODEL ND-2

The Synchronous Differential Null Detector, Model ND-2, is the high resolution null indicating instrument used in both the Weinschel Dual Channel Insertion Loss Measuring System, previously described, and the Weinschel Precision Microwave Phase Bridge described on page 27. The addition of the ND-2 and Model BA-1 Bolometer Preamplifier to the BA-5 in a Single Channel System forms a Dual Channel System and increases the system's accuracy to a maximum of ± 0.02 db per 10 db over a 35 db range depending upon external accessories. The variable sensitivity control of the ND-2 provides a resolution on the unbalance indicator of better than 0.002 db R.F., per division.

The ND-2 may be used in any application where a balance must be indicated between two (2) coherent 1000 cps signal voltages. A difference in phase or a change in the ratio of the two (2) input signals will produce an unbalance indication.

The instrument features a synchronous detector which responds to the 1Kc signal but does not react appreciably to noise. Continuously variable phase shifting is provided in one of the input chan-

nels to allow a null in phase as well as amplitude to be adjusted. The amplifier has a lin-log operation which gives maximum sensitivity as the null is approached but prevents large unbalance signals from overloading the amplifier.

SPECIFICATIONS

FREQUENCY RESPONSE:

Band Center Frequency: 1000 cps (compatible with Weinschel Attenuator Calibrator Model BA-5).

Bandwidth: Approximately 50 cps. Rejection at 2000 cps (Second Harmonic of Fundamental 1000 cps. **Signal:** More than 70 db.

INPUT IMPEDANCES:

Measurement Input: About 1 megohm. **Reference Input:** About 1 megohm.

RANGE OF INPUT VOLTAGE LEVELS: 0.2 to 1.3 V rms (same for both inputs).

PHASE SHIFTER: Range: 400° continuously variable.

Level Stability: Changes less than 0.5% for a 30° change in phase of the output signal.

INDICATORS:

Fine Meter, Scales: 0.002 db/div. or 0.01 db/div. **Time Constant:** Variable between 1 and 8 seconds. **Coarse Meter, Time Constant:** Fixed at 0.5 second.

EQUALITY OF INPUT VOLTAGE LEVELS AT BALANCE: Equal within $\pm 1\%$. (Can be adjusted to $\pm 0.025\%$ by means of chassis mounted control.)

BALANCE STABILITY:

For any proportional change in both inputs of $\pm 25\%$ between:	Balance will be maintained to:
0.2 and 0.7 rms	0.002 db (RF)
0.7 and 1.3 V rms	0.005 db (RF)

*Corresponds at generator variation of ± 1 db (RF).

POWER REQUIREMENTS:

Line Voltage: 115/220 V. If no special instructions are supplied, the unit is wired for 115 V operation. Specifications will be maintained for any line voltage between 105 and 125 V for 115 V operation and between 205 and 235 V for 220 V operation.

Line Frequency: 50/60 cps. **Power Consumption:** About 200 VA.

SHIPPING WEIGHT: 54 lb. (min.)

● MODEL BA-1D BOLOMETER PREAMPLIFIER

Bolometer Preamplifier, Model BA-1D, is a tuned 1Kc voltage amplifier, primarily designed to amplify the detected, audio modulated R.F. Signal from a bolometer or crystal detector. The BA-1D serves just such a function when used in the Weinschel Dual Channel Insertion Loss Measurement System. In this application a sample of the incident R.F. level in the system is detected by a square law detector, amplified by the BA-1D, and applied to the reference input of the Model ND-2 Synchronous Differential Null Detector. This reference signal automatically compensates for amplitude changes in the R.F. Source.

The amplifier has a gain of approximately 10,000 at a fixed tuned frequency of 1000 cps. The BA-1D features a low equivalent noise level of 0.03 μ v and an output circuit that is linear within 0.05 db, R.F., equivalent, up to 30V. Using a square law detector, a 40db dynamic range can be covered at R.F. with a signal to noise ratio that is never less than 8 to 1.

Like the BA-5, the BA-1D can also be used with both bolometers and crystals. An adjustable bolometer biasing circuit is incorporated into the input circuit along with a bolometer burnout protection circuit. This feature eliminates the need for turning off the bias supply when connecting or disconnecting the bolometer or when turning the instrument on or off.



MODEL BA-1D

SPECIFICATIONS

VOLTAGE GAIN: 10,000 minimum at the maximum setting of the 14 to 1 gain control. **STABILITY:** The gain varies less than 0.1 db for a ± 10 volt change in the 115V line source.

FREQUENCY: Tuned to 1000 ± 2 cps.

BANDWIDTH: 30 ± 5 cps between 3 db points.

LINEARITY: 0.05 db RF equivalent up to 30V output. 0.01 db RF equivalent up to 3V output.

EQUIVALENT NOISE: 0.03 μ V rms referred to the input with a shielded 200 Ω wire-wound resistor on the input terminals.

INPUT IMPEDANCE: 30,000 Ω .

OUTPUT IMPEDANCE: Less than 100K Ω . Designed for use with a load that has an input impedance greater than 1 megohm.

BOLOMETER BIAS CURRENT: Adjustable from 0 to 10 ma and indicated on a front panel meter. The bolometer can be connected or disconnected and the power switch turned on or off without damage to the bolometer.

CONNECTORS: BNC female for both input and output.

POWER REQUIREMENTS: **Line Voltage:** 115V $\pm 10\%$. Optional 220V $\pm 7\%$.

Line Frequency: 50/60 cps. **Power:** 40 VA.

DIMENSIONS—Standard Relay Rack Panel: 8 $\frac{3}{4}$ "x19"x13 $\frac{1}{2}$ " deep.

Cabinet Size: 10"x19-3/16"x13-1/2".

WEIGHT: Net, 27 lbs. with cabinet. **Shipping,** 45 lbs. with cabinet.



AUDIO SUBSTITUTION INSTRUMENTS

● MODEL MO-1C MODULATOR

The Model MO-1C is basically a 1000 cps modulator. It provides both sine-wave and square-wave outputs with independently variable amplitude controls. The sine-wave is adjustable up to 20 volts RMS while the square-wave can be varied up to 150 volts peak-to-peak.

An internal fixed frequency tuning fork supplies a 1000 cps output that is stable to within 0.01% in frequency. This high degree of stability is extremely useful where phase sensitive detection is employed. A typical application that requires this order of frequency stability is in the Weinschel Dual Channel Insertion Loss Measurement System. Phase sensitive detection is used in both indicating circuits of the Model ND-2 Synchronous Differential Null Detector; therefore slight modulation frequency changes show up as amplitude changes with the results that the entire system appears unstable. A second mode of operation enables a 1Kc signal from an internal Wien bridge to be varied over a ± 15 cps range. This allows "peaking" of the modulation signal to the center frequency of external equipment. For frequencies other than 1000 cps, an external 10 Volt RMS signal of any frequency between 400 and 3000 cps can be applied to the MO-1C input. The sine and square wave outputs will be synchronized to this external frequency.

Uses include triggering internal modulation circuits of signal generators and repeller modulating commercial medium-power klystrons.

INTERNAL OSCILLATOR

	Adjustable Oscillator	Tuning fork Oscillator
Nominal Frequency	1000 CPS	1000 CPS
Range of frequency adjustment	± 15 CPS	None
Frequency stability	± 0.1 CPS per hr. after 30 minutes warm-up ± 0.5 CPS per 8 hours ± 0.05 CPS for change of line voltage of 10%	$\pm 0.01\%$ total with line voltage and time (8 hrs.)



Ψ MODEL MO-1C

SPECIFICATIONS

SQUARE WAVE OUTPUT: 0-150 volts peak to peak coupled through a 2μ fd 1000-volt condenser from cathode follower of source impedance below 200 ohms. Recommended load is 100,000 ohms minimum. The rise and decay times are less than 5 micro-seconds.

SINE WAVE OUTPUT: 0-20 volts rms. Source impedance less than 100,000 ohms minimum.

AMPLITUDE STABILITY: 1% for change of line voltage between specified limits, independent of the amplitude of external synchronization.

EXTERNAL SYNCHRONIZATION: The internal Wien bridge oscillator is disconnected by means of a panel-mounted switch. External 10 volts rms are required into a 100,000-ohm load. This synchronizes both sine-wave and square-wave output relative in frequency.

FREQUENCY RANGE (WITH EXTERNAL SYNCHRONIZATION): 400 to 3000 cps (external oscillator, Hewlett-Packard No. 200 CD or similar).

LINE VOLTAGE: 115/220V. If no special instructions are supplied, the unit is wired for 115V operation. Stability specifications will be met for any line voltage between 105 and 125V for 115V operation and between 205 and 235V for 220V operation.

LINE FREQUENCY: 50/60 cps.

POWER CONSUMPTION: About 110 VA.

PANEL CONTROLS: "Fine Freq. Adjust," "Synch. Selector," "Power ON-OFF," "Output,"

SHIPPING WEIGHT: 47 lbs. (min.)

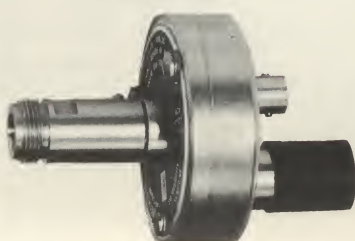
ACCESSORIES

Weinschel Engineering has a complete line of accessory components for use in the Single Channel or Dual Channel Insertion Loss Measurement Systems. Most of these items, some of which are shown here, were specifically designed for these applications and assure the optimum in system performance. A section on Test Accessories, including specifications, is contained in this catalog on pages 12, 13 and 14. For help in selecting the proper accessories, request Weinschel Application Notes 1 and 4 which describe the Single and Dual Channel Systems respectively in detail.

Ψ MODEL 936-X



Ψ MODEL 926



Ψ MODEL DS-109M



Ψ MODEL 936-N

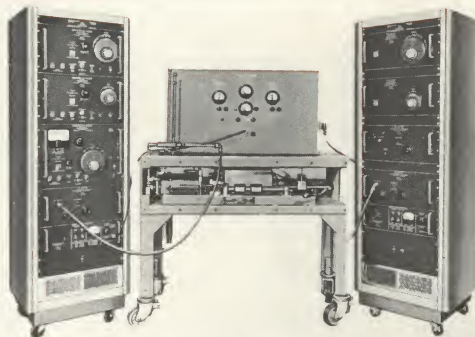


Ψ MODEL 1000R

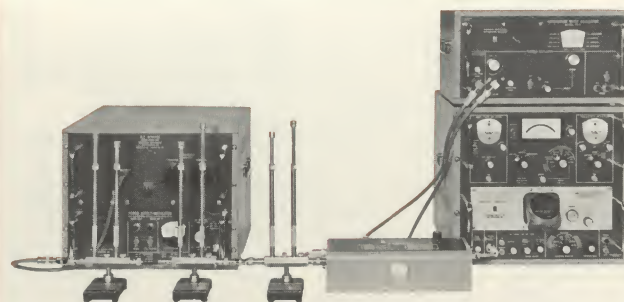




I. F. SUBSTITUTION SYSTEMS



VM-1E SYSTEM



VM-3 SYSTEM

The I.F. Substitution method uses a precision waveguide below cutoff attenuator as the substitution standard. This type of attenuator not only has great dynamic range, but the attenuation depends, to first order, on the diameter of the circular waveguide and may be checked against mechanical standards. The systems described here are basically Heterodyne Receivers that operate at an I.F. of 30 Mc; therefore, the substitution attenuators used are designed to operate at the same frequency. The accuracy and resolution of the I.F. systems are equal to or better than those of the Dual Channel systems, but the real advantage is in Dynamic Range. Both the VM-1E and VM-3 are capable of measuring up to 100db in one step.

The I.F. Systems are normally more expensive than the audio systems because two R.F. sources are required for each frequency range. One source is used as a signal source and the other as a local oscillator. In order to minimize this duplication of equipment and at the same time reduce the initial expense, Weinschel Engineering developed a single unit Harmonic Oscillator-Mixer,

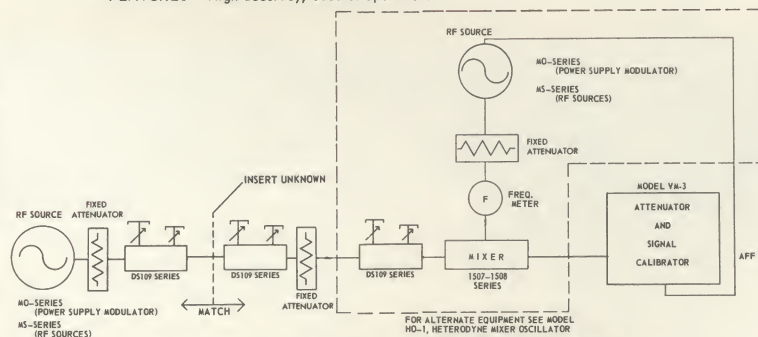
Model HO-1. This small, compact accessory unit serves as a local oscillator and mixer over the entire frequency range from 10mc to 12.4Gc. Although the use of the HO-1 reduces the one step dynamic range of the I.F. systems, it actually replaces four mixers and eight individual local oscillators with their associated power supplies. If the full 100db range is required, the use of the individual plug-in R.F. Sources described on page 34 is recommended.

The two I.F. Systems described on the following pages operate over the frequency range between 10 Mc and 18.0 Gc, limited only by the availability of suitable mixers. These systems, although identical in theory and operating principle, differ somewhat in purpose and performance. The VM-3 serves as either a production or laboratory instrument capable of making R.F. power ratio measurements under a variety of conditions (CW or externally modulated signals) and is completely compatible with practically all types of signal generators. The VM-1 on the other hand is a laboratory standard. Its specifications have been conservatively written to provide the customer with a standard of unequalled performance. The

INSERTION LOSS MEASUREMENTS

RANGE - 100 db.

FEATURES - High accuracy, ease of operation.



PARALLEL IF SUBSTITUTION SYSTEM

precision alignment, massive construction, and optical readout of the VM-1E standard attenuator combine to give accurate repeatable measurements over many years of dependable, trouble-free operation. The VM-1E is, therefore, more restricted in its use with external accessory equipment so as not to derate the obtainable accuracy of the system.

The VM-3/HO-1 Combination is recommended for those applications that require a dynamic range of up to 80db. The VM-3, individual plug-in R.F. Sources, and conventional mixers (1507/1508

series) should be used for power ratio measurements up to 100db or for calibrating signal generator output attenuators. The VM-3 may also be used to measure percent modulation AM and incidental FM up to 1 Mc.

For the Primary Standards Laboratory where the highest obtainable accuracy, repeatability, and range of measurements is required, we recommend, the VM-1E along with the Weinschel plug-in R.F. Sources and 1507/1508 series of conventional mixers.



I.F. SUBSTITUTION INSTRUMENTS

● MODEL VM-3 . . . ATTENUATOR AND SIGNAL CALIBRATOR



MODEL VM-3

The Attenuator and Signal Calibrator, Model VM-3, is basically a highly sensitive 30 Mc receiver which utilizes parallel I.F. substitution to accurately measure insertion loss up to 100db in a single step.

The design of the VM-3 is based on Weinschel Engineering's years of experience in manufacturing its larger and more accurate predecessor, the VM-1. The VM-3 answers the requirement for a less accurate, less expensive instrument capable of the same 100db dynamic range as the VM-1. Some additional circuits were incorporated to increase the versatility of the unit and at the same time make it equally suitable for use on the production line as well as in the standard laboratory. Among these additional circuits are internal diode switches that enable the system to operate with CW R.F. sources and a patented* internal noise balance circuit to extend the CW range of the instrument. Modulation measuring cir-

cuits were also included for measurement of incidental FM up to 1 Mc peak to peak, and calibration of the AM percent modulation circuits of a signal generator. The VM-3 features the same backlash free optical readout as the VM-1 with only slightly less resolution (0.005db per division).

For calibrating signal generators, including the output attenuators, the full 100db range is desirable and the Weinschel Plug-in type R.F. Sources (see page 34) should be used as local oscillators in conjunction with the Weinschel 1507/1508 series of mixers. For calibrating rotary vane attenuators, directional couplers or other devices of less than 70db, the Model HO-1 Heterodyne Mixer-Oscillator is ideal. A frequency range from 10 Mc to 12.4 Gc is covered by this single L.O./Mixer package with a dynamic range that varies from approximately 80db up to about 95db depending on the frequency range.

*U.S. PAT. NO. 3,098,968; 3,104,354; Re 25,396.

SPECIFICATIONS

SIGNAL, FOR LOSS MEASUREMENTS AND RECEIVER OPERATION: CW or 100% square wave modulated by 1000 cps signal from VM-3 (full range operation with either signal).

MEASUREMENTS AT RF

Single Step—100 db maximum RF

Step	Accuracy
20 db RF	±0.02 db
40 db RF	±0.04 db
60 db RF	±0.07 db
80 db RF	±0.27 db
100 db RF	±0.50 db

INCREMENTAL ACCURACY/10 DB STEP

RF Signal Level at Mixer Input	Accuracy	
—15 to —25 dbm	0.10 db	Effect of mixer nonlinearity
—25 to —35 dbm	0.02 db	
—35 to —85 dbm	0.01 db	
—85 to —95 dbm	0.1 db	Av. (0.05 db Max. for 50 db range); 0.015 db/10 db Max.
—95 to —105 dbm	0.2 db	
—105 to —115 dbm	0.3 db	
		Effect of noise

NULL METER SENSITIVITY (CENTER BALANCE): 0.1 db minimum (minus to plus) full scale from —15 to —90 dbm. 1.0 db minimum (minus to plus) full scale from —90 to —115 dbm.

Note: Total scale length about one inch for 10 divisions (±5 about center).

AMPLITUDE MODULATION: Meter Ranges: 35% and 100% modulation full scale on 4½" meter.

FREQUENCY MODULATION: Meter Ranges: 100 Kc and 1 Mc peak to peak full scale. **Accuracy:** ±15% of full scale. **Maximum Simultaneous AM:** 90%.

RECEIVER OPERATION: Sensitivity: —130 dbm at 30 Mc.

AFF—"FAST," "SLOW": Search-Lock on Range: ±5 Mc.

30 MC ATTENUATOR: Readout: Optical Micrometer. **Mechanical Accuracy:** ±0.0001". **Attenuator Accuracy:** >0.01 db/10 db at 30 Mc over linear range. **Range:** 140 db total.

POWER INPUT: 105-125/200-240 V, 50/60 cps. Approximately 200 W.

DIMENSIONS: Out of Cabinet—19" wide rack panel; 15¾" high; 18½" depth behind panel; 3" panel to front of guard handles. **In Cabinet**—21" wide, including side carrying handles; 17½" high; 19" deep cabinet plus 3" to front of panel guards.

WEIGHT: 95 lbs., including cabinet; **Shipping (Min.),** 150 lbs.



I.F. SUBSTITUTION INSTRUMENTS

● MODEL HO-1 . . . HETERODYNE MIXER-OSCILLATOR

The Model HO-1 is a complete local oscillator mixer package for the heterodyne conversion of signals in the frequency range from 10 Mc to 12.4 Gc. Primarily designed for use with the Weinschel Model VM-1 and VM-3 attenuation measuring systems, the HO-1 is also compatible with any similar type heterodyne receiver that operates at a 30 Mc I.F. frequency.

In order to obtain such broadband operation from a single package, some sacrifice in dynamic range is necessary; however, the savings in cost and space, coupled with the convenience and simplicity of a single unit, more than offset the reduction in range. With either the VM-1 or the VM-3, one-step measurements in the order of 80 to 95db are possible, depending on the frequency.

The HO-1 consists of two (2) separate units. The basic HO-1 harmonic oscillator and the HO-A mixer package. A direct reading frequency dial is used on the oscillator that is calibrated for operation in the fundamental, harmonic, and dual conversion modes. The HO-A is supplied as part of the HO-1 and includes a double stub tuner and all necessary interconnecting cables. The HO-A contains the necessary directional couplers, filters, and diode mixers to convert an external signal of — 10dbm to a 30 Mc I.F. over the full frequency range of 10 Mc to 12,400 Mc.

An AFF (Automatic Frequency Follower) input jack is provided on the HO-1 to lock the oscillator or its harmonic to a 30 Mc difference from the signal frequency. This AFF feature not only operates at the higher frequencies, but also at the 10 Mc end. This is a distinct advantage over conventional local oscillators which use triodes at the lower frequencies and are not compatible with an AFC circuit. The AFF correction signal is produced in the VM-1 or VM-3.

This single compact local oscillator-mixer combination utilizes only 10 inches of rack panel space, yet covers the frequency range which normally requires at least 7 or 8 separate local oscillators with associated power supplies and mixers.



☞ MODEL HO-1

SPECIFICATIONS

SIGNAL FREQUENCY RANGE: 10 Mc to 12.4 Gc.

I.F. OUTPUT FREQUENCY: 30 Mc.

SMALLEST USABLE RF SIGNAL: (Read on VM-3)

10 to 1990 Mc: — 100 dbm	4150 to 8300 Mc: — 100 dbm
1990 to 4150 Mc: — 110 dbm	6200 to 12,400 Mc: — 95 dbm

DYNAMIC RANGE:*

10 to 1990	85 db (Double Conversion)
1990 to 4150	95 db (Fundamental Mixing)
4150 to 8300	85 db (2nd Harmonic Mixing)
6200 to 12,400	80 db (3rd Harmonic Mixing)

MAXIMUM RF INPUT LEVEL: 10 Mc to 12.4 Gc: — 10 dbm.

OUTPUT RF CONNECTORS: Type N.

AUTOMATIC FREQUENCY CONTROL: Input signal jack on back of chassis.

MODULATION: Input BNC jacks to both oscillators for repeller modulation using external signal.

POWER: 115V/230V; 50/60 cps; Approx. 175W.

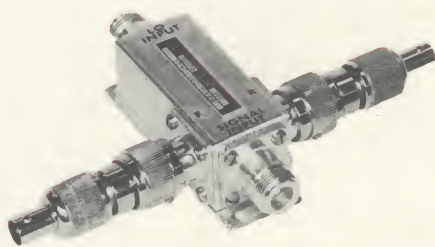
EQUIPMENT SUPPLIED: One model HO-1 Heterodyne Mixer-Oscillator (including cabinet); one Model HO-A Heterodyne Mixer; one Model DS-109 Double Stub Tuner; two cable assemblies.

DIMENSIONS: Model HO-1: Width 21", Height 10", Depth 15". Model HO-A: Width 6", Height 5", Length 14".

SHIPPING WEIGHT (includes extra equipment): 120 lbs.

*Using Model VM-1 or VM-3.

● MODEL 1507/1508 COAXIAL AND WAVEGUIDE MIXERS . . . 10 Mc-18.0 Gc



☞ MODEL 1507



☞ MODEL 1508

The Model 1507/1508 mixers are recommended for use as accessories with both the Model VM-1 and Model VM-3 I.F. Substitution Systems.

The 1507 series is designed to operate from low power local oscillators of the "O" to +4dbm variety and cover the frequency range from 10 Mc to 11 Gc in five (5) models. Hybrids are used on all models to isolate the local oscillator and signal channels. Above 1 Gc two (2) tunnel diode mixers are used in parallel; below 1 Gc two (2) parallel crystal mixers are used. Because of the action of the hybrid, the input VSWR is relatively low, and for many applications it is not necessary to tune the input signal channel.

The broadband 1508 series covers the frequency range from 1 Gc to 18 Gc in four (4) models but require higher local oscillator power. Two of the mixers cover the coaxial frequency range from 1 to 10 Gc and the other two (2) cover X-band and K_u-band (12.4-18 Gc) in waveguide. The Model 1508 series requires at least 20 milliwatts of local oscillator power since the coupling between the local oscillator and mixer is made through 10db couplers. Also, since only one mixer is used, the input VSWR is generally higher than on the 1507 series. Either series may be used with Weinschel R.F. Sources as local oscillators.



VSWR, IMPEDANCE AND PHASE INSTRUMENTS

● MODEL 1800 . . . STABILIZED SWR INDICATOR

The new, all solid-state Model 1800 Stabilized SWR Indicator has several unique features that set it aside from other high performance SWR indicators. One of these features is the high resolution 1.06 VSWR (0.5db) expanded scale. A second feature is an AGC circuit which practically eliminates measurement errors contributed by amplitude variations of the R.F. Source. This permits effective use of the expanded range for making VSWR or Insertion Loss Measurements. The AGC, or level compensation, also allows the instrument to be used as a ratio meter in slow sweep reflectometer measurements and high reflection coefficient measurements (0.5db full scale corresponds to a VSWR of 35:1).

In addition to the above, the 1800 contains a high-gain, low noise, tuned 1 Kc amplifier with variable center frequency and bandwidth which provides for greater sensitivity. The internal bolometer biasing circuits enable operation with either barretters or crystals and feature burnout protection. Both AC and DC outputs are available for driving external indicators or recorders.

For applications requiring more precise insertion loss measurements, the Model 1800 can be ordered as the Model 1801 Stabilized Attenuation Calibrator. (See page 18.) The 1801 contains a precision Audio Substitution Attenuator which is used to keep the amplifier level constant while making insertion loss measurements. This eliminates errors caused by nonlinearity of amplifier and meter. An optional external battery pack (Model 1800Z) is available for both the Model 1800 and Model 1801.



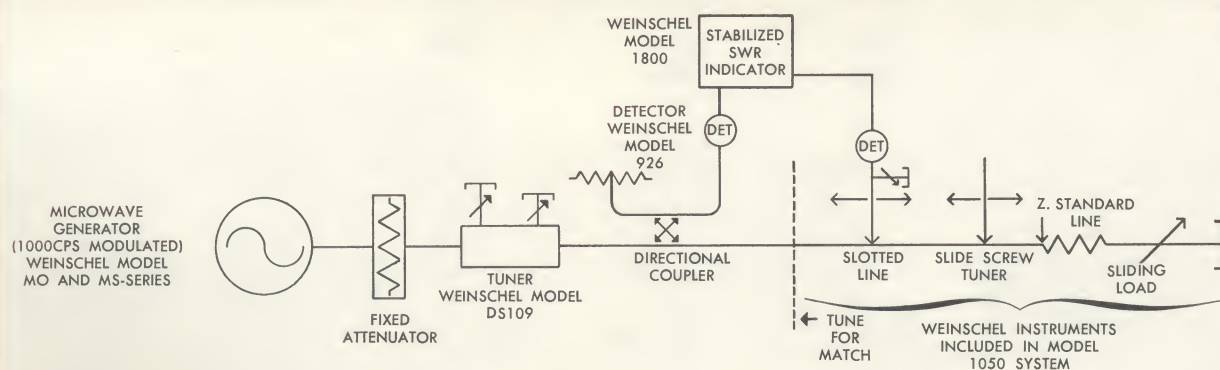
MODEL 1800

SPECIFICATIONS

	SIGNAL AMPLIFIER	AGC AMPLIFIER
FREQUENCY	1000 cps adjustable ± 20 cps	Broadband
BANDWIDTH	Adjustable 30 to 100 cps approx.	
RF DETECTORS	Square law crystal or barretter	Square law crystal or barretter.
BARRETTTER BIAS	4.5 to 9 ma constant current source with full barretter burnout protection.	4.5 to 9 ma constant current source with full barretter burnout protection.
INPUT IMPEDANCE	2,000 ohms barretter (nominal) 50,000 ohms crystal (nominal)	4000 ohms barretter (nominal). 50,000 ohms crystal (nominal).
INPUT RANGE		.3 μ V-3 mV, Full Scale
REGULATION		± 0.03 db meter change for ± 1 db change in RF level
AGC TIME CONSTANT		.2 sec. (nominal).

CALIBRATED METER AND SWITCH: Operating Model: Six 10 db Normal; Four 2.5 db Expand; One 0.5 db Expand (1.06); **Voltage Gain:** 5×10^6 nominal; 0.3 μ V signal for full scale deflection; **AC Output:** 1.5 V(rms) maximum output from 10 ohm source impedance, Load > 5000 ohms; **DC Output:** 0-50 mV DC Load > 5000 ohms; **Primary Power:** 105-125/210-250V, 50/60 cps, 30VA.

WEIGHT: Net, 16½ lbs.; Shipping (Min.), 21 lbs.



MODEL 1050 BLOCK DIAGRAM



● MODEL 1050 . . . PRECISION TUNABLE IMPEDANCE MEASURING SYSTEM

The Model 1050 is a complete impedance measuring system operating over the frequency range from 1 to 6 Gc. The system includes a Model 1000R slotted line, motor drive, tuner, sliding load, measurement bench, and Model 1800 Stabilized SWR Indicator. The system can be used as an absolute standard since its accuracy is determined by the precisely held mechanical dimensions of a 14 MM air line which houses the 50 ohm sliding load. The load and slotted line are both fitted with GR type 900 connectors.

The sliding load and slotted line probe are mechan-

ically linked and automatically cycled by a motor drive. This provides a constant phase relationship between probe and load. Cyclic variations in probe output are then caused almost entirely by mismatches which are tuned out using the built-in tuner on the 1000R slotted line. The residual of the slotted line and adaptors can be tuned out to 1.002 with respect to the 50 ohm standard.

The 1.002 VSWR would be highly impractical were it not for the high resolution of the Model 1800 with its AGC circuit to compensate for level changes in the R.F. Source.

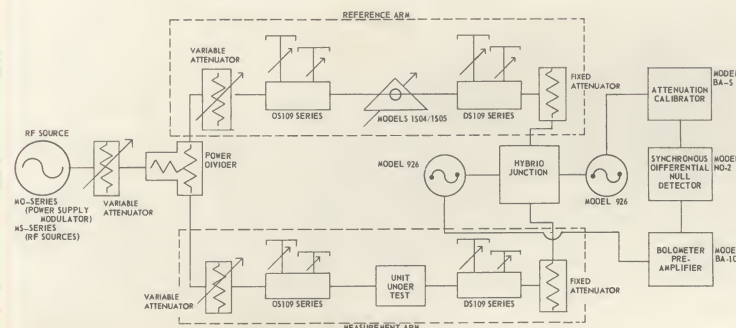


VSWR, IMPEDANCE AND PHASE INSTRUMENTS

PHASE MEASUREMENTS

RANGE — 360° from 1–12 Gc.

FEATURES — Measurements on components with up to 35 db of loss.



PHASE BRIDGE

In the block diagram of the Insertion Loss Insensitive Microwave Phase Bridge shown above, the 1000 cps square-wave modulated RF signal is divided equally into two channels by a broadband resistive power divider. One channel contains the Model 1505 phase shifter. The unknown phase shift component can be inserted in the other. The channels terminate in a pair of isolated ports of a hybrid junction. Bolometer mounts are connected to the remaining two ports. The bolometer outputs (1000 cps) are amplified and coupled to the ND-2 null detector. A null in the ND-2 output indicates equality of these two inputs.

Because of the vector relationship, when the phase in the unknown arm is changed the amplitude of the audio signals from the two detectors goes in opposite directions. By readjusting the phase standard, the two audio signals

can again be made equal and balance is restored. The phase change required to do this is equal to the phase change in the measurement arm and is the difference of the readings on the scale of the phase standard.

Since the input to both detectors is the vector sum of the reference and measurement arm signals, a balance is obtained even when loss is introduced by the unknown. The resolution needed to detect balance, however, is increased when considerable loss from the unknown greatly decreases the size of this one vector. Measurements on components with up to 40 db of loss are possible only because of the great resolution of the Model ND-2. Since this is a bridge arrangement, small changes in oscillator power level have no effect on the measurement.

The standard Ψ Dual Channel Insertion Loss Measurement System (page 17) is readily converted into the phase bridge with the addition of a few components.

● MODEL 1504/1505 PRECISION PHASE SHIFTERS



Ψ MODEL 1504

The combination of Ψ Precision Phase Shifters with the Ψ Dual Channel System provides a simple means of making accurate insertion and differential phase measurements. The 1 to 12 Gc frequency range of the phase shifters may be extended down to much lower frequencies when components with small phase shifts are to be measured. The phase shift range in degrees varies proportionately with frequency from 360°. The difference in the two models is a 3db lossy line attenuator that is built into both input and output of the Model 1505. The low VSWR of these elements coupled with their isolation, reduces possible errors due to impedance interaction effects by a factor of 4.

One of the major features of the Ψ Phase Measuring System is that high resolution measurements can be made on components with up to 30db of insertion loss. The null indicating instruments used in the Phase Measurement System are the same as those used in the Weinschel Dual Channel Insertion Loss Measurement System described on page 17. This new application increases the versatility of the Dual Channel System to cover both phase and insertion loss. The instruments, recommended accessories, and operation of the phase bridge is described in detail in Weinschel Application Note No. 7, which is available upon request.

SPECIFICATIONS

	1504	1505
Frequency Range	1–12 Gc	1–12 Gc
Impedance	50 ohms	50 ohms
Max. phase shift	360° at 1 Gc	360° at 1 Gc
Insertion Loss	3600° at 10 Gc	3600° at 10 Gc
VSWR	1.5 db maximum	8 db maximum
	1.25 max. 1 to 6 Gc	1.20 max. 1 to 12 Gc.
	1.30 max. 6 to 12 Gc	
Connectors	Type N female	Type N female
Scale Resolution	0.05 mm. 0.1°/Gc	0.05 mm. 0.1°/Gc
Input Power	1W Average	5W Average
Case dimensions	1"x4 $\frac{7}{8}$ "x18 $\frac{3}{4}$ "	1"x4 $\frac{7}{8}$ "x31"
Shipping weight	16 lbs.	28 lbs.



POWER MEASURING INSTRUMENTS

● MODEL PB-1B . . . PRECISION R.F. POWER BRIDGE

The Precision R.F. Power Bridge, Model PB-1B, is capable of accuracies of 0.1% in the measurement of DC substituted power. The accuracy of this measurement is a major factor in the calibration of Bolometer Mounts. The bridge employs pure DC for both the bias and substituted power, eliminating the errors normally associated with AC bridge circuitry.* Another advantage in the use of pure DC is that the measurements can be made directly traceable to primary DC standards.

The simplicity of the PB-1B with its extremely stable, solid-state, regulated DC supply provides long term, trouble free operation with a minimum of maintenance.

The PB-1B can be used with any 100 or 200 ohm, grounded or ungrounded, thermistor or barretter mounts requiring from 3 to 15 milliamperes bias current. Because of the high accuracy and resolution of the bridge, a mount with a long thermal time constant or a thermostated mount such as the Weinschel 935 or 904 series of thermistor mounts should be used. These mounts prevent fast drifts that would deteriorate the precision of the measurement. Calibration Factors are also supplied with these mounts to increase the accuracy of the measurement. The PB-1B in conjunction with a calibrated mount-directional coupler combination can be used as a standard for the calibration of other mounts, power detectors, and R.F. power meters.

*Raff, S. J. and Sorger, G. U., "A Subtle Error in RF Power Measurements," IRE Transactions on Instrumentation, Vol. 1-9, Number 2, September, 1960.



☞ MODEL TB-3

SPECIFICATIONS

RF POWER LEVEL: TB-2A; 1.00 mw. TB-3; 10.0 mw.

ACCURACY OF SUBSTITUTED DC POWER:

Without correction for bias power: For bias power = 30 mw; $\pm 0.15\%$.

For bias power between 28.5 and 31.5 mw; $\pm 0.2\%$.

With correction for bias power: For bias power between 24 to 36 mw; 0.15%.

DC BIAS POWER RANGE: 24 to 36 milliwatts, 11 to 13.5 milliamperes.

DC BIAS POWER STABILITY: Less than 1 microwatt per minute, constant line voltage; less than 1 microwatt, line voltage change of 10%.

CALIBRATION FACTOR RANGE: 0.85 to 1.05.

SENSITIVITY OF BRIDGE BALANCE INDICATION: Controlled by a 4 position front panel switch to set galvanometer sensitivity.

Position	Per Division of Galvanometer Deflection	
	TB-2A	TB-3
1	Shorted	Shorted
2	100 $\pm 20\%$ microwatts	1 $\pm 20\%$ milliwatt
3	10 $\pm 20\%$ microwatts	100 $\pm 20\%$ microwatts
4	Max.-Approx. 2 microwatts	Approx. 2 microwatts

CONNECTORS:

Thermistor Mount: Front panel mounted female BNC.

PRIMARY POWER: TB-2A—115V/220V, 50/60 cps.

TB-3—115V/50 or 60 cps. 220V/50 or 60 cps.

SHIPPING WEIGHT (MIN): TB-2A, 50 lbs.; TB-3, 42 lbs.



☞ MODEL PB-1B

SPECIFICATIONS

DC SUBSTITUTION ACCURACY (using recommended accessories, thermally stable mount and stable RF source):

For 4.5 ma barretter; 0.1% $\pm 1/2$ microwatt. For 8.75 ma barretter; 0.1% ± 1 microwatt. For 13 ma thermistor, 0.1% $\pm 1/2$ microwatt.

RANGE OF MEASUREMENT OF RF POWER:

Using 4.5 ma barretter; 0.1 to 3 milliwatts. Using 8.75 ma barretter; 0.1 to 12 milliwatts. Using 13 ma thermistor; 0.1 to 20 milliwatts.

RANGE OF STANDARD CELL COMPENSATOR: 1.017 to 1.020 volts.

STABILITY OF BIAS SUPPLY: Change of bias voltage with line voltage variation of 105-125 volts; less than 0.001%.

Maximum change of bias voltage is less than 5×10^{-6} for 2 minutes, 1×10^{-6} for 1 hour and 1×10^{-8} for eight hours with a constant line voltage.

RECOMMENDED AMBIENT TEMPERATURE RANGE: 25° $\pm$ 2° C.

BIAS CURRENT CONTROL: 4.5, 8.75 and 13 milliamperes nominal.

CONNECTORS: 10 heavy duty binding posts for external standard cells, galvanometer, precision potentiometer and bolometer mount.

CONSTRUCTION: Rack mounting.

DIMENSIONS: 19" x 11 1/4" x 8" deep.

WEIGHT: 30 pounds.

SHIPPING WEIGHT: 39 lbs. (Min.)

LINE VOLTAGE: 105-125 volts, 200-240 volts, 50-60 cps.

NECESSARY ACCESSORIES: Two std. cells; One Galvanometer; One Precision D.C. Potentiometer.

● TB-2A AND TB-3 . . . THERMISTOR BRIDGES

The Model TB-2A and TB-3 are both precision, fixed power level, thermistor bridges capable of measuring 1 milliwatt and 10 milliwatts, respectively. The very high 0.15% accuracy and simplicity of these bridges is attributed to measuring only fixed levels. These bridges use pure DC as bias and substitution power, which allows them to be self-calibrating against an internal standard cell and traceable to primary DC standards. When used with thermally stable calibrated mounts, such as the Weinschel 904 or 935 series, the calibration factor of the mount can be set on a front panel control of the bridge to compensate for errors of the mount. A built-in galvanometer is used as null indicator and provides a maximum sensitivity of approximately 2 microwatts per division.

Among the many uses of the TB-2A and TB-3 are calibrating the "0" dbm or "+10" dbm reference levels of standard signal generators using a terminating mount, or in-line power monitoring of system power levels. In this application, a calibrated mount-directional coupler combination is used. The mount-coupler may also be used to establish a known incident RF power level at the coupler output. If a bolometer mount is connected to this point and the DC substituted power measured with a ☞ Model PB-1B Precision RF Power Bridge, the calibration factor can be very accurately determined.



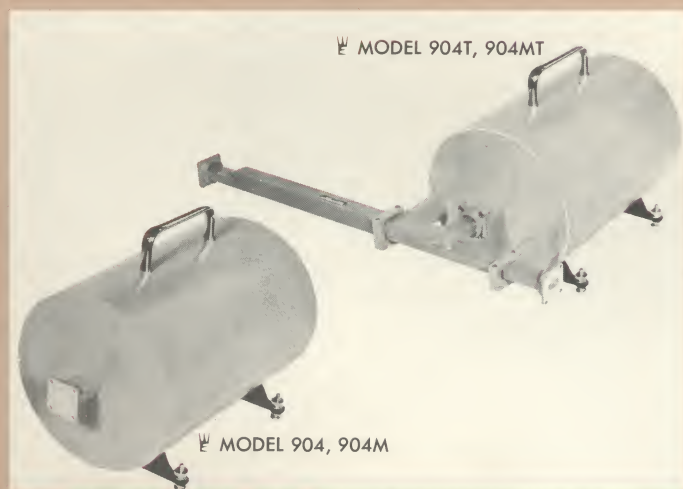
POWER MEASURING INSTRUMENTS

● MODEL 904 . . . BROADBAND THERMISTOR MOUNTS

The Model 904 Series of broadband thermistor mounts are fixed tuned bolometric instruments used for the precise measurement of microwave power with standards accuracy. These mounts operate over the full X-band waveguide frequency range and feature calibrations traceable to NBS along with excellent temperature stability. The temperature stability is accomplished by encasing the mount in a thermostatically controlled, thermally isolated, constant temperature chamber. Each unit contains an inner and outer chamber with inner and outer electrical heaters and a special thermal isolator to minimize heat flow through the waveguide.

Available in four models, the basic 904 requires a bias power of 30 milliwatts DC for operation at 200 ohms while the Model 904M requires 11 milliwatts DC for 200 ohm operation. The Models 904T and 904MT are identical to the 904 and 904M respectively except for the addition of a 3db directional coupler which is permanently attached to the mount. The 904 and 904T mounts are designed for use specifically with the Weinschel TB-2A and TB-3 Thermistor Bridges which operate only at 30 milliwatt DC bias levels. The Weinschel Precision Power Bridge Model PB-1B can be used with any of the 904 series.

The 904 series thermistor mounts are supplied with calibration factors traceable to National Standards. These calibrations can be transferred to uncalibrated mounts when using the 904T or 904MT mounts which have the permanently attached directional couplers. This same mount-coupler combination is also used to measure or monitor in-line power flow or to calibrate bolometer mount and power meter combinations at fixed levels.

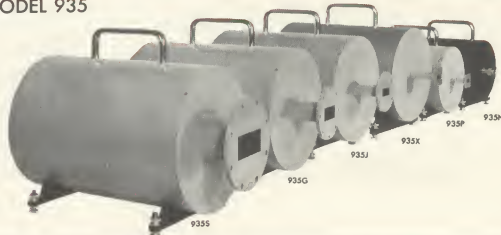


SPECIFICATIONS

	MODEL 904, 904M	MODEL 904T, 904MT
Frequency Range	8.2-12.4 Gc	8.2-12.4 Gc
Input VSWR	1.5 max. (904), 1.30 max (904M)	1.35 max. (904T), 1.25 max. (904MT)
Equivalent Output VSWR	N/A	1.05 max.
Operating Resistance	200 ohms	200 ohms
DC Bias Power	30 mw (904), 11 mw (904M)	30 mw (904T), 11 mw (904MT)
Calibration Frequency	9.8 Gc	9.8 Gc
Accuracy of Calibration Factor	±2%	±2%
Input Connector	UG-39/U	UG 39/U
Output Connectors	Binding Post (2)	Binding Posts (2)
Equivalent Drift in terms of Bias Power	.1 μ w/min.	.1 μ w/min.
After 12 Hours Warmup	2 μ w/hr.	2 μ w/hr.
(Amb. Temp. 25 ± 2° C.)	3 μ w/8 hrs.	3 μ w/8 hrs.
Heater Power	Inner, 190 watts; Outer, 260 watts	Inner, 190 watts; Outer, 260 watts
A/C Power Requirement	110 Volts (nom.)	110 Volts (nom.)
Weight	35 lbs. (shipping)	35 lbs. (shipping)

● MODEL 935 . . . BROADBAND THERMISTOR MOUNTS

MODEL 935



The 935 series of Thermistor Mounts covers the frequency range from 10 Mc to 18 Gc. The six broadband thermally isolated models include five waveguide sizes plus one co-axial unit. Each terminating thermistor mount is encased in a thick layer of plastic foam. A special thermal isolator is in series

with the transmission line to limit heat conduction along the metallic path. This special design and construction eliminates the effect of rapid variations in ambient temperature on the resistance of the thermistor element, which greatly increases the stability and accuracy of the microwave power measurement.

These Thermistor Mounts are supplied with calibration factors traceable to NBS in some frequency ranges. Calibrations at special frequencies are also available. If power flow measurements or higher power levels are to be measured, the mounts can be supplied with directional couplers attached. For greatest accuracy, the coupler should be permanently attached prior to calibration. The calibrated mount-coupler combination can also be used to transfer the calibration to uncalibrated terminating bolometer mounts.

SPECIFICATIONS

	COAX			WAVEGUIDE		
Model Number	935N	935S	935G	935J	935X	935P
Frequency Range	10 Mc-10 Gc	2.6-3.95 Gc	3.95-5.85 Gc	5.85-8.2 Gc	8.2-12.4 Gc	12.4-18.0 Gc
VSWR (max.)	1.5	1.5	1.5	1.5	1.5	1.5
Operating Resistance	200 ohms	200 ohms	200 ohms	200 ohms	200 ohms	200 ohms
D.C. Bias Power (200 Ω)	30 mw	30 mw	30 mw	30 mw	30 mw	23 mw
Calibration Frequencies	1 Gc, 9 Gc	3.0 Gc	5.0 Gc	7.0 Gc	9.8 Gc	15 Gc
Standard						
Accuracy of Calibration Factor	±2% up to 4 Gc ±2.5% up to 10 Gc	±3%	±3%	±3%	±2%	±2.5%
Input Connector	Type N Female	UG 53/U	UG149/AU	UG 344/U	UG 39/U	UG 419/U
Output	Binding Posts	Binding Posts	Binding Posts	Binding Posts	Binding Posts	Binding Posts
Weight (net/shipping)	7 lbs./15 lbs.	15 lbs./25 lbs.	15 lbs./25 lbs.	15 lbs./25 lbs.	8 lb. 10 oz./16 lbs.	4 lb. 6 oz./15 lbs.
Diameter (body)	6 1/2"	8 1/2"	8 1/2"	8 1/2"	8 1/2"	6 1/2"
Length (body)	7 1/4"	12"	12"	12"	12"	8"

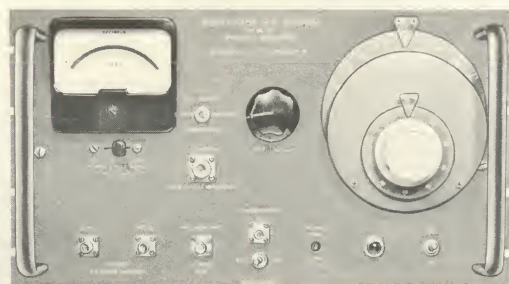


MICROWAVE SIGNAL SOURCES

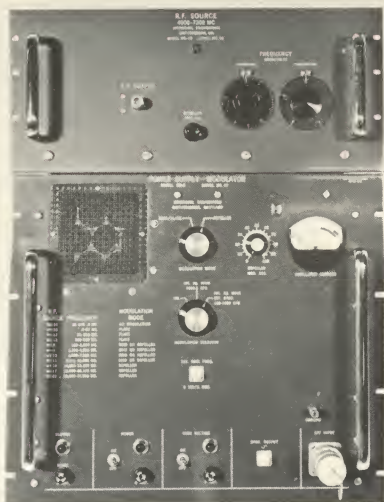
● SELF-CONTAINED MICROWAVE SOURCES . . . 0.05 Gc-2.00 Gc

Each of these Ψ sources, Models MS-1, 2, and 3 contains its own internal triode oscillator, modulator, and power supply. Together, the three instruments cover the frequency range between 50 Mc and 2 Gc. These sources feature a regulated R.F. output which is independent of load. The regulator circuit acts to maintain either a constant incident power or a constant voltage at a chosen terminal of the transmission line depending on how the control signal is derived. When operated in the regulated mode, the R.F. output is indicated on a front panel meter. This operation simulates a match on a "0" impedance source.

The sources may be operated CW or 100% square wave modulated. The output is fixed when operated in the regulated mode and adjustable up to at least 40 to 100 milliwatts for unregulated operation depending on the source model.



Ψ MODEL MS-1



Ψ MODEL MO-5 AND SOURCE

● PLUG-IN SOURCES . . . 20 CPS-10.5 Gc

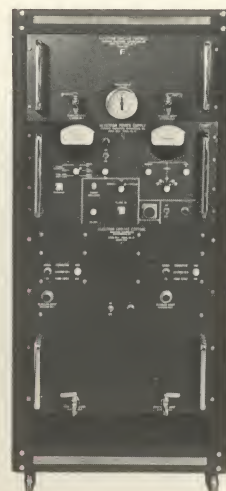
The Ψ plug-in sources (Models MS-8 thru MS-15) are a series of oscillators which may be interchangeably plugged into one basic power supply-modulator unit (Models MO-3 or MO-5).

Beam and repeller voltage adjustments are not required as in most universal klystron power supplies, but are automatically selected and applied as each source is plugged in. The source dials are direct reading in frequency and in the klystron units, repeller voltage is automatically tracked.

The frequency range from 20 cps to 920 Mc is covered with four separate plug-in triode oscillator units. The range from 900 Mc to 10.5 Gc is covered with four plug-in external cavity klystron units. These cavities have shorting plungers of non-contacting Z-type for low tuning noise and negligible wear. The combination of super-honed cavities and low-loss shorts assure stable, long, reliable, and maintenance free service. All sources have minimum outputs between 20 and 200 milliwatts.

● ULTRA-STABLE MICROWAVE SOURCES 7.5 Gc-18.0 Gc

The Ψ Stable Sources consist of a series of shielded internal cavity klystrons, Models MS-30, 31, and 32, plus a water cooling unit, Model KC-1, and a power supply Model MO-4. The frequency range from 7.5 to 18.0 Gc is covered in three waveguide sizes by three separate R.F. sources, even under modulation. The high amplitude and frequency stability and low incidental FM of these sources results from the use of special circuits in the Model MO-4 klystron power supply plus low microphonics and stable temperature contributed by the Model KC-1, water cooling unit. Each source is housed in separate shield box with R.F. filters on all leads and is supplied with a directional coupler, wavemeter, and detector for frequency setting. A thermostat protects the klystron against damage from overheating. The minimum output of these sources ranges from 50 milliwatts for X_b and X-bands to 25 milliwatts in K_u Band.



Ψ MODEL KC-1

Ψ MODEL MO-4
(SEE PAGE 35)



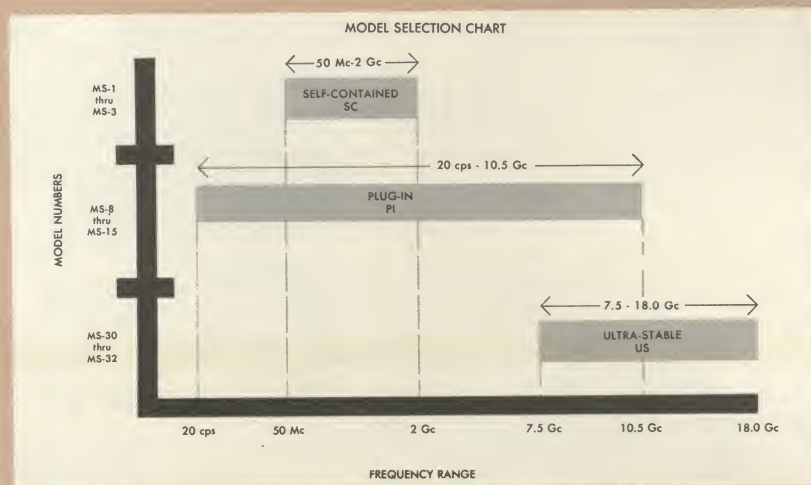
Ψ MODEL MS-30



MICROWAVE SIGNAL SOURCES

APPLICATIONS AND SELECTION

The chart and table shown below are provided to assist in selecting the proper RF source for various applications. The chart shows the frequency ranges for the three different types of sources manufactured by Weinschel Engineering and in particular, shows the overlapping frequencies where two types of sources are available and a choice must be made.



The following table lists three basic measurement systems manufactured by Weinschel Engineering and indicates, by frequency range, the type of sources recommended for each system. In cases where two types of sources are available consideration should be given to overall frequency range as well as to future frequency and measurement requirements.

	20 cps-50 Mc	50-250 Mc	250-920 Mc	900-2200 Mc	2 Gc-7.5 Gc	7.5-10.5 Gc	10.5-18.0 Gc
Power Measurements (PB-1B, TB-2A, TB-3)	PI	PI or SC	PI or SC	PI or SC	PI	PI or US	US
Parallel I.F. Substitution (VM-1, VM-3)	PI	PI or SC*	PI or SC	PI or SC*	PI‡	PI‡ or US	US
Audio Substitution (Single or Dual Channel and Phase Measurements)	PI	PI or SC†	PI or SC†	PI or SC†	PI	PI or US§	US§

*No capability for automatic frequency follower (AFF). Use as signal source only.

†Need external modulator (MO-1C) for dual channel.

‡Recommend use of Power Supply Modulator Model MO-5 with VM-1 system.

§Need external modulator (MO-1C).

PI = Plug-in US = Ultra Stable

SC = Self-Contained

● SELF CONTAINED MICROWAVE SOURCES

	MODEL MS-1	MODEL MS-2	MODEL MS-3
Frequency Range	50-250 Mc	250-920 Mc	900-2000 Mc
Frequency Calibration Accuracy	±1%	±1%	±1%
Internal Modulating Frequency	1000.0 cps (Externally Variable)	1000.0 cps (Externally Variable)	1000.0 cps (Externally Variable)
Maximum Avg. Power Output (100% Square-Wave Modulation)	40 mw	100 mw	50 mw
Amplitude Stability (With Directional Coupler and Regulator)	±0.05 db/hr.	±0.05 db/hr.	±0.05 db/hr.
Frequency Drift (Warm-Up)	04.%	0.2%	0.1%
Frequency Control	6 in. dial calibrated over 140° (Precision drive)	4 in. dial calibrated over 270° (Precision drive)	6 in. dial calibrated over 200° (Precision drive)
Dimensions	10½" x 19" x 13"	10½" x 19" x 13"	14" x 19" x 13"
Shipping Weight	95 lbs.	95 lbs.	105 lbs.
A/C Power Requirements *	115V±10% 60 cps	115V±10% 60 cps	115V±10% 60 cps

* 50 cycle AC can be supplied at extra cost.



MICROWAVE SIGNAL SOURCES

● PLUG-IN R.F. SOURCES AND POWER SUPPLY—MODULATORS

Specifications given below for the Plug-in sources were obtained using the Model MO-3, Power Supply-Modulator. When these sources are used with the higher performance Model MO-5, Power Supply-Modulator, specifications for frequency and amplitude stability are improved and there is lower incidental FM for both the CW and 100% modulated conditions. The MO-5 has better regulation, less noise and ripple, DC regulated filaments for the RF sources, and provision for repeller modulating the klystron sources. These improvements over the MO-3 make the MO-5 the recommended Power Supply-Modulator for use with the Weinschel VM-1, parallel IF substitution system, where the highest performance is usually required.



☞ MODEL MO-3 AND SOURCE

SPECIFICATIONS

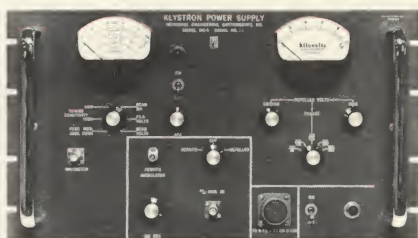
	MS-14	MS-15	MS-12A	MS-13	MS-8	MS-9	MS-10	MS-11	MO-3	MO-5
FREQUENCY:	20 cps to 500 Kc	.5 Mc to 50 Mc	50 Mc to 250 Mc	250 Mc to 920 Mc	900 Mc to 2200 Mc	2.1 Gc to 4.2 Gc	4.0 Gc to 7.3 Gc	7.2 Gc to 10.5 Gc	---	---
Range										
Stability (With Constant Line Voltage)	±.1%	±.1%	±.1%	±.1%	.01% in 8 hrs. .001% in 15 min.	.01% in 8 hrs. .001% in 15 min.	.01% in 8 hrs. .001% in 15 min.	.01% in 8 hrs. .001% in 15 min.	---	---
Indicator Accuracy	±3%	±2%	±1%	±1%	±1%	±1%	±1%	±1%	---	---
Indicator Calibration	Non Linear	Non Linear	Non Linear	Approx. Log.	Linear	Linear	Linear	Linear	---	---
Resettability	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	---	---
Deviation with ±10% Line Voltage Change	<±.1%	<±.1%	<±.1%	<±.1%	<.05%	<.05%	<.01%	<.01%	---	---
Spurious FM when operated CW peak to peak	---	---	<.002%	<20 Kc	<.002%	<.009%	<.002%	<.002%	---	---
POWER OUTPUT										
CW (min.) for 50 Ω load	>1 volt	200 mw	50 mw	60 mw	20 mw	50 mw 2.3-4.2 Gc 30 mw 2.1-2.6 Gc	50 mw	30 mw 7.4 to 9.7 Gc 20 mw 7.2 to 7.4 Gc 20 mw 9.7 to 10.5 Gc	---	---
100% Modulated peak power (min.) for 50 Ω load	---	---	50 mw	60 mw	100 mw	50 mw 2.3-4.2 Gc 30 mw 2.1-2.6 Gc	50 mw	30 mw 7.4 to 9.7 Gc 20 mw 7.2 to 7.4 Gc 20 mw 9.7 to 10.5 Gc	---	---
Stability (with constant line voltage)	±.03db in 8 hrs.	±.03db in 8 hrs.	±.03 db in 8 hrs.	±.03 db in 8 hrs.	±.03db in 8 hrs.	±.03db in 8 hrs.	±.03db in 8 hrs.	±.03db in 8 hrs.	---	---
Deviation with ±10% line voltage change	<±.03db	<±.03db	<±.03 db	<±.03db	<±.03db	<±.03db	<±.03db	<±.03db	---	---
100% SQ. WAVE AM										
Maximum Rise Time	---	---	10 μ sec	10 μ sec	4 μ sec	4 μ sec	4 μ sec	4 μ sec	---	---
Internal Synch.	---	---	1000.0 cps ±.01%	1000.0 cps ±.01%	1000.0 cps ±.01%	1000.0 cps ±.01%	1000.0 cps ±.01%	1000.0 cps ±.01%	---	---
Range of External Synch.	---	---	400-10,000 cps	400-10,000 cps	400-10,000 cps	400-10,000 cps	400-10,000 cps	400-10,000 cps	---	---
DIMENSIONS:										
Height, Width, Depth	8¼"x19"x9"	8¼"x19"x9"	8¼" x 19" x 9"	8¼" x 19" x 9"	8¼" x 19" x 9"	8¼" x 19" x 9"	8¼ x 19" x 9"	8¼ x 19" x 9"	13" x 19" x 20"	25" x 19" x 17"
Shipping Weight	35 lbs.	35 lbs.	35 lbs.	40 lbs.	45 lbs.	45 lbs.	41 lbs.	41 lbs.	102 lbs.	165 lbs.



MICROWAVE SIGNAL SOURCES

● ULTRA STABLE MICROWAVE SOURCES

MODEL NUMBER	MS-30	MS-31	MS-32
FREQUENCY			
Range	7.5-10.0 Gc	8.2-12.4 Gc	12.4-18.0 Gc
Indicator Accuracy	Accuracy of direct reading wavemeter is $\pm 1\%$	Accuracy of direct reading wavemeter is $\pm 0.1\%$	Accuracy of direct reading wavemeter is 0.1%
Incidental FM	When operated cw or when 100% square wave modulated the incidental FM is less than 20 KC	When operated cw or when 100% square wave modulated the incidental FM is less than 20 KC	When operated cw or when 100% square wave modulated the incidental FM is less than 20 KC
POWER OUTPUT			
CW (Minimum)	50 milliwatts into matched load	50 milliwatts into matched load	25 milliwatts into matched load
100% Square Wave Modulated Peak Power	50 milliwatts into matched load	50 milliwatts into matched load	25 milliwatts into matched load
EQUIPMENT SUPPLIED			
Klystron	Varian X-13B tunable internal cavity klystron	Varian X-13 tunable internal cavity klystron	Varian X-12 tunable internal cavity klystron
Shield Box	Includes RF filters on all leads	Includes RF filters on all leads	Includes RF filters on all leads
Water Jackets	Includes thermostat preset to 120°F and interlocked with power supply for klystron protection	Includes thermostat preset to 120°F and interlocked with power supply for klystron protection	Includes thermostat preset at 120°F and interlocked with power supply for klystron protection
Adapter	RG-51/U to RG-52/U		
Directional Coupler	20 db multihole coupler	20 db multihole coupler	20 db multihole coupler
Wavemeter	Direct reading cavity type	Direct reading cavity type	Direct reading cavity type
Crystal Detector	RG-51/U Waveguide input	RG-52/U Waveguide	RG-91/U Waveguide
Cables and Connectors	All cables, connectors and hoses necessary for making connections to power supply and cooling unit	All cables, connectors and hoses necessary for making connections to power supply and cooling unit	All cables, connectors and hoses necessary for making connections to power supply and cooling unit
DIMENSIONS			
Shield Box	Approximately 7"x8"x7"	Approximately 7"x8"x7"	Approximately 7"x8"x7"
Waveguide Size	RG-51/U	RG-52/U	RG-91/U
Output Flanges	UG-51/U	UG-39/U	UG-419/U
Shipping Weight	42 lbs.	29 lbs.	35 lbs.



☞ MODEL MO-4

● KLYSTRON COOLING CONTROL

SPECIFICATIONS MODEL KC-1

WATER CAPACITY: Approximately 4 gallons.

FLOW: Gravity flow with float actuated recirculating pump.

OUTPUTS: Two water outlets with individual shut-offs will cool either one or two klystrons.

POWER REQUIREMENTS: 115V ac, 60 cps.

DIMENSIONS: Supplied in standard 6' closed relay rack. Panel opening is 19" wide. Upper unit panel is 8 1/4" high. Lower unit panel is 19 1/4" high.

SHIPPING WEIGHT: 189 lbs.

● MODEL MO-4

	VOLTAGE	STABILITY	CURRENT	REGULATION	RIPPLE & NOISE
BEAM SUPPLY	Variable between -400V DC and 550V DC. Monitored on front panel meter.	Short time: $\pm 0.01\%$ Long time: $\pm 0.1\%$	65 milliamps maximum. Monitored on front panel meter.	For $\pm 10\%$ line voltage variation: $\pm 0.01\%$	Less than 500 microvolts rms
REPELLER SUPPLY	Variable by means of coarse and fine front panel controls from -45V DC to -650V DC. Monitored on front panel meter.	Short time: $\pm 0.01\%$ Long time: $\pm 0.1\%$		For $\pm 10\%$ line voltage variation: $\pm 0.01\%$	Less than 1.0 millivolt rms
KLYSTRON HEATER SUPPLY	6.3V DC $\pm 5\%$ (over load range). Monitored on front panel meter.		0.5 Amp maximum	For $\pm 10\%$ line voltage variation: $\pm 1\%$	Less than 10 millivolts rms

SHIPPING WEIGHT 62 lbs.



SPECIAL PRODUCTS

● MODEL 1802 . . . MICROWAVE INTERFEROMETER

The 1802 is a non-contacting displacement indicator with very high resolution. This instrument can be used to measure random or periodic displacements of any surface that reflects microwave energy. This surface need not be metallic. The non-contacting feature allows dynamic measurements to be made on items under environmental conditions such as inside vacuum chambers, ovens, etc. Applications include calibration of accelerometers, measurement of surface irregularity, thermal expansion, "out of roundness" resulting from dynamic stress, and many others. The 1802 has a resolution of 1 microinch dynamic and 10 microinches static.



☞ MODEL 1802

● MODEL PCS-1B . . . PULSE POWER CALIBRATOR



☞ MODEL PCS-1B

Pulse Power can be measured in the range between -10dbm and $+63\text{dbm}$ using the Model PCS-1B. The frequency range of the instrument is between 925 and 1225 Mc. Measurements are accurate to better than $\pm 0.5\text{db}$ and are independent of pulse repetition rate. The PCS-1B uses the notch watt meter principle and contains its own oscilloscope, reference oscillator, and power bridge. This instrument can also be used for the calibration of pulse power measuring devices and as a test set for checking out TACAN and IFF equipment.

● IMPROVED MODEL BDS . . . X-BAND RADAR TEST SET

The Model BDS is a general purpose X-Band Radar Test Set with a self-contained power meter, frequency meter, and signal generator. In the frequency range of 8500 to 9600 Mc, the BDS is used for testing and adjusting radar sets, beacons, and associated equipment. The accuracy of measurements in this range, made possible by the use of an exclusive alloy, LA-685, is $\pm 1\text{ Mc}$ for cavity temperatures in the range of -15° to $+45^\circ\text{C}$. The power measurements are accurate to $\pm 1.5\text{db}$ between $+1$ and $+30\text{dbm}$. The signal generator can supply CW, frequency modulated, square-wave modulated or pulse modulated outputs accurately adjustable between $+8$ and -105dbm .



☞ MODEL BDS



ORDERING INFORMATION

- How to order. . . . Order by the catalog model number and the name of the instrument desired. When you desire exceptions to the standard models, please give specific instructions and specifications.
- Where to order. . . . Make your order out to Weinschel Engineering and send directly to Weinschel Engineering in order to facilitate processing. Orders placed through the local Ψ sales representative should be made out to Weinschel Engineering, care of the representative.
- Terms. . . . Terms to customers with established credit are net 30 days. If credit has not been established, remit cash or allow C.O.D. shipment to avoid delay. Terms for overseas customers must be arranged with the Ψ export department or through the local representative.
- Minimum billing. . . . Orders for spare parts or replacement components amounting to \$10.00 net or less, will be billed at \$10.00 plus shipping costs.
- Shipping. . . . All Weinschel products are priced for shipment F.O.B. Gaithersburg, Maryland, unless quoted otherwise. Shipment will be made by the method most economical and serviceable to the customer, unless specifically requested otherwise. Title to the product passes with delivery to the carrier.
- Applications Assistance. . . . Technical assistance in selecting equipment for resolving microwave measurement problems and preparing orders is available without charge. Qualified applications engineers operate out of Ψ offices. Write or telephone Weinschel Engineering or your local representative for assistance with your special problem.
- Repairs. . . . A service facility to repair and recalibrate any Ψ instrument is maintained at Gaithersburg, Maryland. In many instances repairs can be made at service facilities maintained by the local Weinschel Engineering representatives. For factory repair or recalibration please contact the Company for instructions before shipment. As much information as possible should be provided as to reason for return. Repairs are made at the cost of materials and labor plus a small service charge, unless warranty is involved. Repair parts may be ordered in the same manner as instruments.

WARRANTY

WE WARRANT each instrument of our manufacture to be free from defects in material and workmanship. Our obligation under this warranty is limited to servicing or adjusting any instrument returned to our factory for that purpose, and to making good at our factory any part or parts thereof except tubes, fuses or batteries. This warranty period is limited to one year after making delivery to the original purchaser, and to equipment which is returned to us with transportation charges prepaid and which, upon our examination, shall be disclosed to have been defective or to have failed in normal service.

THIS IS SELLER'S SOLE WARRANTY WITH RESPECT TO THE GOODS. SELLER MAKES NO OTHER WARRANTY OF ANY KIND WHATEVER, EXPRESS OR IMPLIED, AND MAKES NO IMPLIED WARRANTIES OF MERCHANTABILITY OR SUCH THAT EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF.

We reserve the right to make changes in design at any time without incurring any obligation to install such changes on units previously sold by us.



Catalog Products Modified To Meet Your Needs

For 16 years Ψ has concentrated on developing more precise microwave components and measuring instruments. Directed by a management that is engineering-oriented, Ψ is producing instruments and devices advancing the state of the art. Our VM-1E Standard Attenuator Comparator and the general purpose Dual Channel Insertion Loss Test System are examples. In addition, the Ψ program of research into the microwave behavior of resistive film materials has produced both fixed and variable attenuators which are recognized as standards of excellence in the field.

When you purchase a component or an instrument which bears the Ψ symbol, you are receiving a precision product designed by one of the industry's most experienced engineering teams and produced by a quality conscious production group.

If you need microwave components or instruments, be sure to investigate the Ψ products. For systems or special applications, we will modify any of our existing products or design new ones to meet your specifications. Complete details are available from our Applications Engineering Department or your nearest Ψ representative.

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MODEL 1 ATTENUATORS (all values) - \$80.00 each

MODEL 2 ATTENUATORS (all values) - \$125.00 each

NOTE: Both Model 1 and Model 2 Precision Fixed Coaxial Attenuators are now available in 3, 6, 10, and 20 db values; in addition, they both operate over the frequency range of DC to 18.0 Gc, with Model 1 having relaxed accuracy and VSWR specifications for the 12.4 - 18.0 Gc portion of the frequency range.